MINING CONGRESS JOURNAL

SAN FRANCISCO WELCOMES MINERS
O INDUSTRY'S BIG EVENT OF THE YEAR
AMC MINING SHOW—SEPTEMBER 22-25

See preview — pages 42 to 63

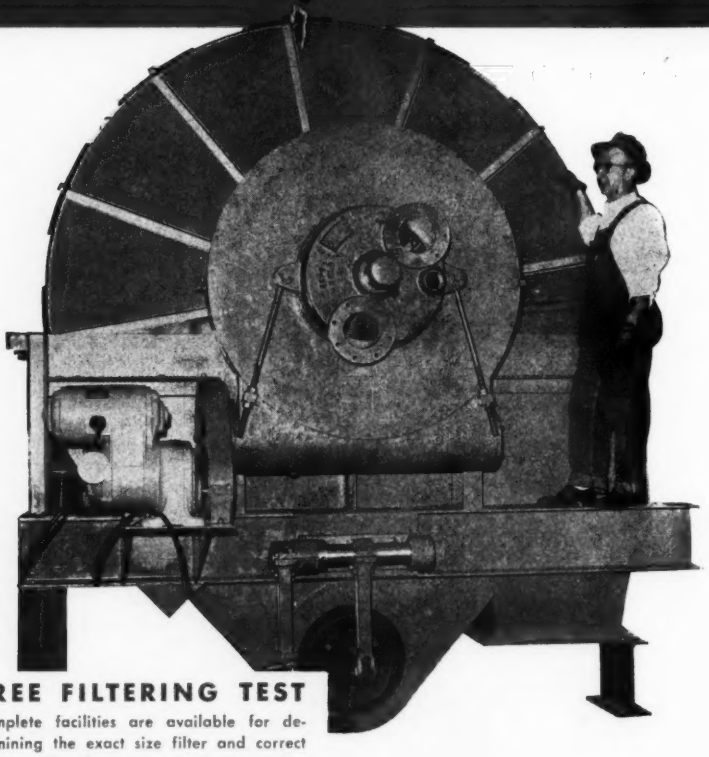
NOW... an Agitator-Type* DENVER Disc Filter

(PATENTED)

for proper pulp agitation

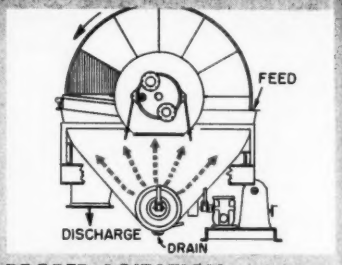
with NO Submerged Bearings
NO Packing Gland
NO Sealing Water
NO Pulp Dilution

Sizes from 2' x 1 Disc through 9' x 12 Discs



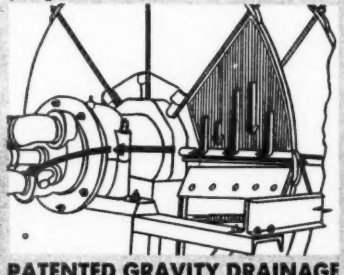
FREE FILTERING TEST

Complete facilities are available for determining the exact size filter and correct filter media for your requirements. No charge is made for these tests. We invite you to contact us and use our services.



PROPER AGITATION upwards from bottom keeps pulp in suspension. Entire tank is active. Gives greater vacuum efficiency, drier cake.

NO SUBMERGED BEARINGS, no grease contamination or gland water to dilute feed. Patented pulsating agitator is sealed in tank with standard rubber diaphragms.



PATENTED GRAVITY DRAINAGE FEATURE removes residual moisture. Prevents trapped filtrate from being blown back into cake. Gives drier filter cake.

VARIABLE SPEED for flexibility in agitation speed and disc speed is available. You adjust filter speed to fit your specific requirements. Simple, low cost.

The firm that makes its friends happier, healthier and wealthier

DECO ENGINEERED — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

Complete Mill Equipment

DENVER EQUIPMENT COMPANY

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MINING CONGRESS JOURNAL

VOLUME 44 **AUGUST 1958** **NUMBER 8**

CONTENTS

Opinions expressed by authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL SECTION

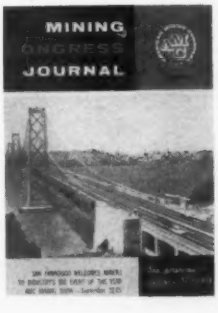
DEPARTMENTS

ON OUR COVER

The place: San Francisco

The time: September 22-25

PLAN TO BE THERE!



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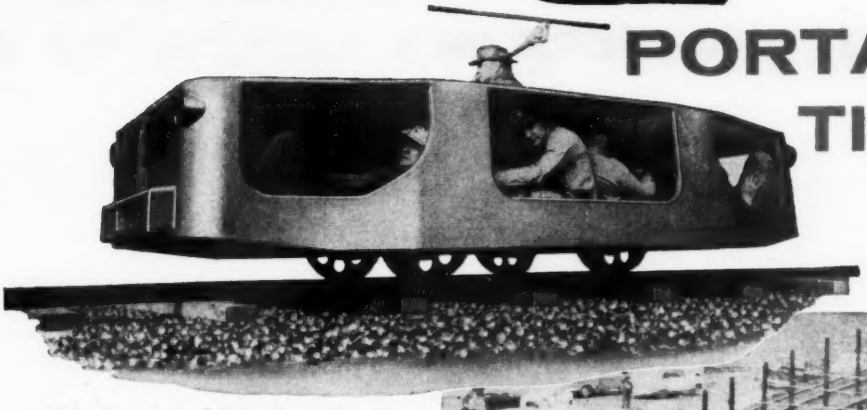
BE OUR GUEST
use CF&I's hospitality center during the AMC show
CF&I
REST & SERVICE CENTER
THERE MUST BE A WATER TAP SOMEWHERE AROUND
THIS BEATS STANDING IN LINE FOR A 'PHONE!
YEAH MAN, AND NEXT I'M GONNA DICTATE A LETTER!
THIS SURE FEELS GOOD TO MY FEET
CF&I HAS A WATER COOLER AT ITS HOSPITALITY CENTER
YOU HANDLE DICTATION, TYPING AND POSTAGE FREE?
YES, SIR! IT'S PART OF CF&I CONVENTION SERVICE
THEY CERTAINLY MAKE THESE BOOTHS INTERESTING THESE DAYS!
MINE DON'T CARE IF I NEVER GET UP!
RIGHT! THESE CF&I DISPLAYS ARE WORTH SEEING!
I COULD SURE USE A FEW MINUTES REST RIGHT NOW!
GOOD! I'LL USE CF&I'S TELEPHONE SERVICE, WHILE YOU'RE AT IT
1958 MINING SHOW • SAN FRANCISCO
SEPT. 22-25
CF&I's BOOTH is 1640
We'll see you there!
THE COLORADO FUEL AND IRON CORPORATION
DENVER • OAKLAND • NEW YORK
6277

You, too, can *reduce* PORTAL TIME *up to 50%!*

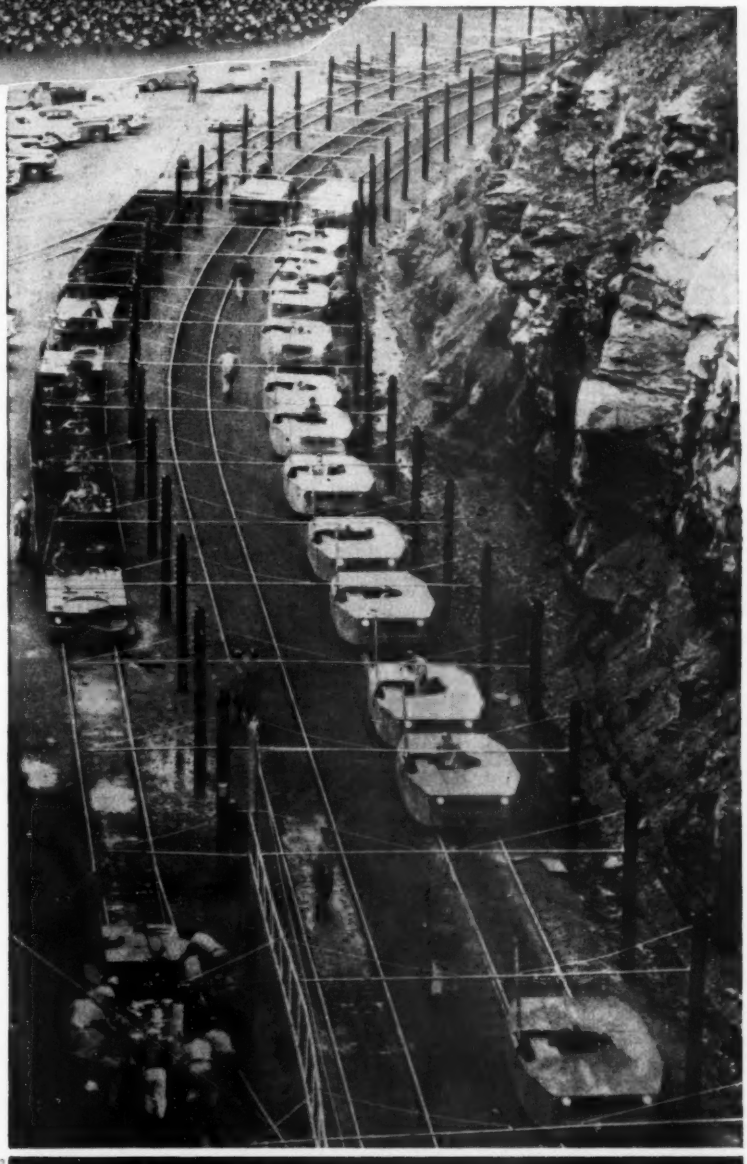


TJ5 Mine Portal Bus, "Low Type"

Lee-Norse *Self-Propelled* MINE PORTAL BUS

Factual performance records prove that the Lee-Norse Mine Portal Bus can effect up to 50% savings in portal time . . . savings that result in more man hours at the section face . . . increased tonnage at a reduction in overall cost per ton.

Built in low and high types to suit your haulage road, the Mine Portal Bus features complete safety —two separate braking systems . . . split-roof design that allows operator full vision at all times.



Get your personnel to and from the working face quicker . . . safer! Check the advantages of the Lee-Norse Mine Portal Bus.

Lee-Norse Company

CHARLEROI, PA.

Accident! But Anaconda SH-D Shovel Cable kept on working in this open-pit mine. Good proof of Anaconda Cable's ability to take it.

CAVE-IN! But this unposed photo shows Anaconda Shovel Cable still working!

Above you see part of an actual cave-in. The Man from Anaconda was Johnny-on-the-spot with a camera, and the picture shows part of what he saw. The complete cave-in was much more extensive.

We use this photo to show how well Anaconda Shovel Cable stands up under abuse. Jagged rocks, sheer drops over cliffs, water-filled ditches—the Anaconda cable is built to endure all these hazards.

We're miners ourselves. All our practical experience—plus knowledge of what makes the best insulation and protective coverings—has gone into this cable.

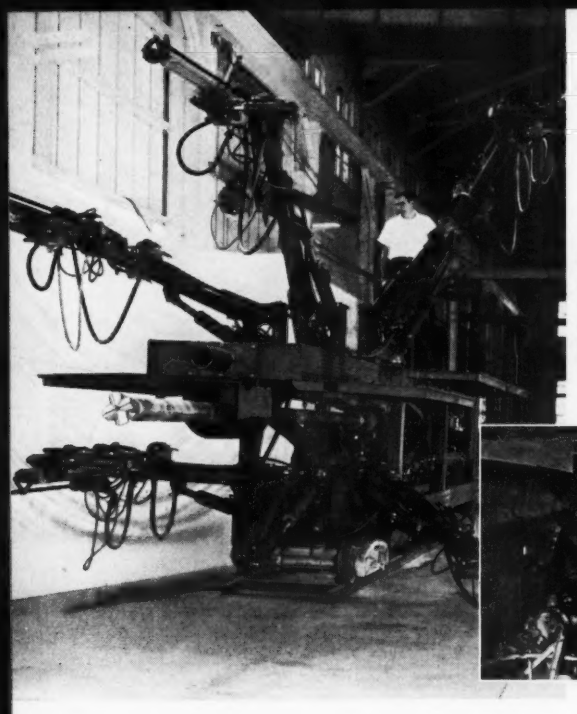
Anaconda Shovel Cable has a strong, extra-tough—yet highly flexible—neoprene jacket. It resists abrasion, mechanical abuse, flame and water. Its long-lasting Anaconda Butyl Insulation has high dielectric strength, and outstanding resistance to ozone, heat and moisture.

It all adds up to a cable that's ready when the going's rough. For full information about this rugged shovel cable, contact the Man from Anaconda or your Anaconda distributor. Or write directly to: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

58317

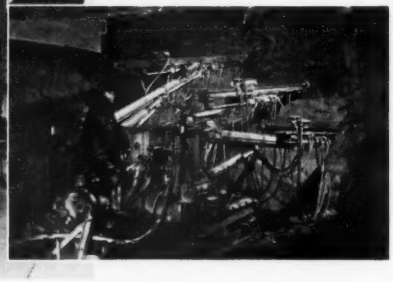
LIVE BETTER ELECTRICALLY

SEE THE MAN FROM **ANACONDA®**
FOR **SHOVEL CABLE**



HYDRA-BOOM JUMBOS convert set-up time into drilling time. There's no job too big or too complex. Let our engineers help solve your unusual drilling problems.

SEND FOR BULLETIN NO. 4196



SHAFT JUMBOS. I-R Hydra-Boom Shaft Jumbos save set-up time, drilling time and manpower on big vertical shaft jobs.

SEND FOR BULLETIN NO. 4188

A CONSTANT STANDARD OF QUALITY

in everything you need for drilling rock

Ingersoll-Rand 5-831

Branch offices in major cities, home office, 11 Broadway, New York City

AMERICAN MINING CONGRESS, San Francisco, September 22-25
Visit Our Booth 522-526-532, Plaza Exhibit Hall

NEW DUSTLESS STOPER. Light-weight, short-leg design with built-in suction and pressure discharge of cuttings. Ideal for clean, low-cost roof bolting.

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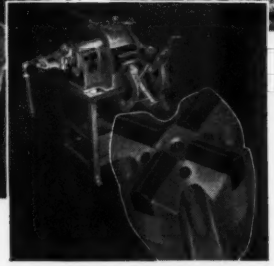


UNIVERSAL JACKDRILL The easiest-handling one man universal drilling unit obtainable; converts quickly to Stoper or Jackhamer drill.

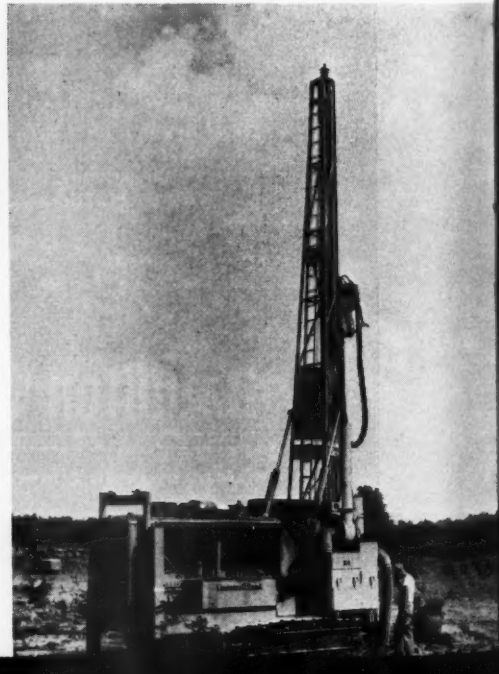
SEND FOR BULLETIN NO. 4144A

CARSET BITS AND SHOP EQUIPMENT . . . a complete line of Carset Bits, bit and rod shop equipment.

SEND FOR BULLETINS NO. 4146, 4187

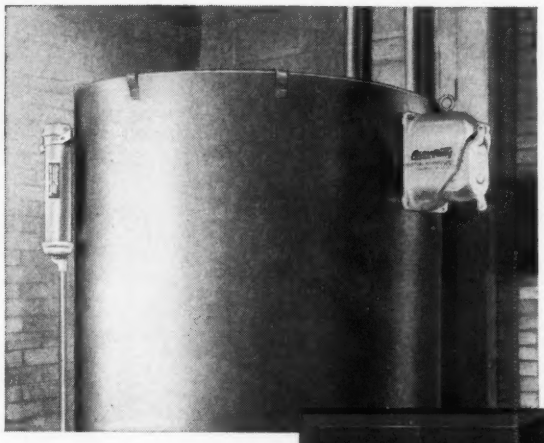
DRILLMASTER. The most versatile and productive blast-hole drilling unit ever developed—completely self-powered and self-propelled.

SEND FOR BULLETIN NO. 4179

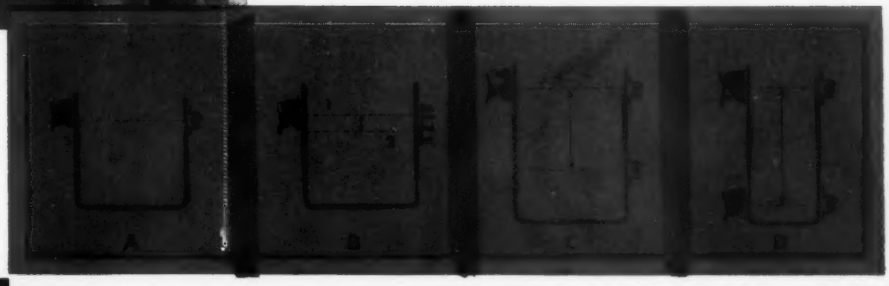


AccuRay... TANK OR BIN LEVEL SYSTEMS

A Level Detector-Controller System Designed to your Requirements



Adaptable to four methods of operation, AccuRay's Detector - Controller offers outstanding advantages over float-level type control systems. It is easily installed and maintained and is priced from only $465.00. The Detector-Controller utilizes two units—a radiation source housing, which provides more than adequate shielding, and a detector. Both units are mounted externally . . . thus are free from fouling by process materials. Accuracies can be maintained to ± 1/8" as a high or low level alarm. The source housing can be pivoted to provide radiation shielding during work inside the tank. Design of the instrument is in accordance with accepted standards for both explosion-proof and weatherproof operations.



another AccuRay advancement for process control

AccuRay® is a registered trademark of Industrial Nucleonics Corporation

High or Low Level Control . . . The detector is mounted diametrically opposite the radiation source. When the material moves above the level of the detector, the radiation is cut off, causing the output relay to change position. When the material drops below the level, the output relay is thrown to its opposite position. **Narrow Band Control** . . . The detector is mounted vertically along the tank, resulting in narrow band control. When the material moves above position (1), a signal is provided from the output relay. The opposite signal is provided when the material drops below level (2). **Wide Band Control** . . . A single source unit is teamed with two detector elements. The material can be controlled within the distance separating the high and low level detectors. The signal can also be used to provide a combination high-low level alarm system. **Extra-Wide Band Control** . . . Two source units are teamed with two detectors in cases where the vertical separation desired is large relative to the tank diameter. This system can also provide a high or low level alarm.

Also available is the AccuRay continuous tank or bin level measurement system . . . Continuous indication of the level of material is read directly from an indicator or recorder. The system may also be instrumented to provide automatic control of level.

Please send complete details on AccuRay Tank or Bin Level Detector-Controllers.

Name ..... Title .....

Company .....

Street .....

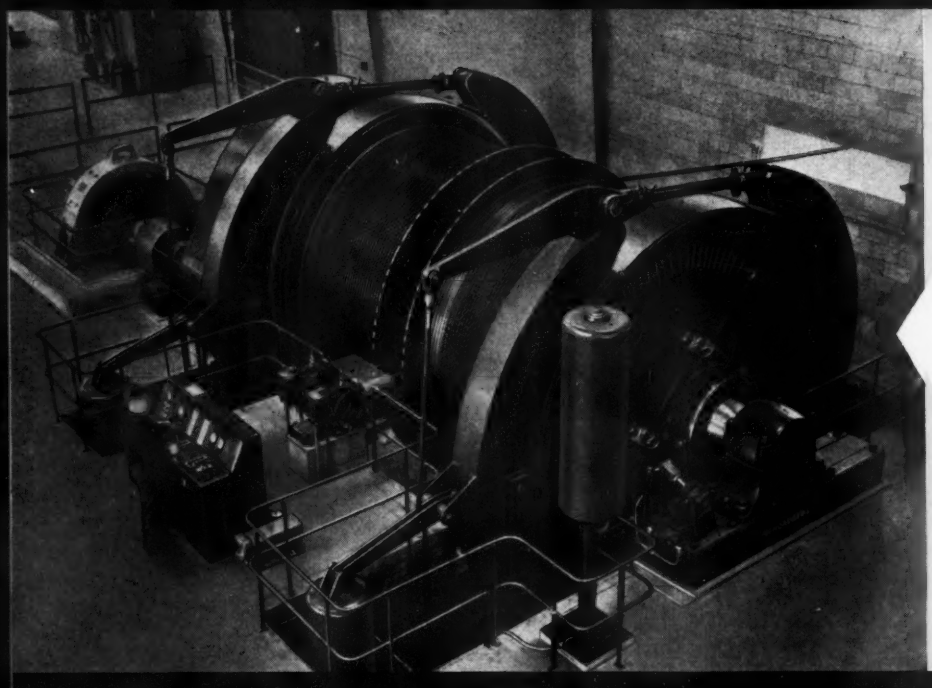
City ..... Zone ..... State .....

Application .....

.....

Industrial Nucleonics
CORPORATION
1165 Chesapeake Ave., Columbus 12, Ohio

See the INDUSTRIAL NUCLEONICS' Exhibit—Booth 317, American Mining Congress Show in San Francisco, September 22-25.



CONVENTIONAL DRUM HOISTS

Typical of the large hoisting machinery built by Nordberg is this conventional 12′ diameter by 84″ face double drum ore hoist which serves a prominent iron producer. This hoist is designed for a depth of 2800 feet, using 10-ton skips and hoisting 14 long tons of ore at a rope speed of 2000 feet per minute.

Nordberg hoists are available for manual, push-button semi-automatic, or fully automatic control.

NORDBERG'S 61 YEARS of MINE HOIST EXPERIENCE can help you select the best hoist to meet your requirements

▶ Why not let over half a century of specialized mine hoist experience help you select the *right* type and size hoist to meet your specific operational requirements?

With the trend toward larger tonnages and more powerful hoists, greater emphasis must be placed on the proven experience and ability of the hoist manufacturer. Here, Nordberg has an established reputation second to none, and can furnish both conventional and friction type hoists. This wide experience is at the call of mine executives everywhere. *Consult Nordberg on your next hoist problem.*

FRICTION TYPE HOISTS

Where applicable, the hoisting of ore, men or materials can be economically handled with Nordberg Friction Hoists . . . built for either counterweighted skip or skips-in-balance operation. Manual, push-button semi-automatic, or fully automatic control available. Outstanding features of the Nordberg design include: One-piece welded steel drum; anti-friction roller bearings throughout; pressure applied—pressure released hydraulic brakes with emergency gravity application.

Illustrated is a 4-rope hoist designed for push-button semi-automatic, multi-level operation, to handle men and material.

NORDBERG MFG. CO.
Milwaukee 1, Wis.

NORDBERG
MINE HOISTS

MH157

Yieldable Arch provides 'safety valve' against squeezing pressures

As its name implies, the Yieldable Arch is designed to give under the squeeze of heavy ground, instead of suddenly letting go. This yielding action gives the overburden a chance to settle slowly into a natural arch around the drift or tunnel.

Each set of Yieldable Arches is made up of rolled U-shaped segments, heavily flanged to resist torsion. Segments nest into one another at the ends to form a sliding joint which is secured by U-bolt clamps. The clamps are drawn up tightly enough to create friction joints which hold fast under normal loads. But when pressures bear down, friction in the joints is overcome and the segments slide, thus acting as a sort of safety valve to keep the steel arch from buckling or deforming under the crushing load.

Yieldable Arches are easy to install; no special tools or fancy equipment is needed. Your own men can set them up and take them down with only a minimum of supervision. And that brings up another important point: Yieldable Arches are usually recoverable for reinstallation elsewhere in the mine. They frequently pay for themselves within the first year of service. One of our engineers will gladly give you full details on the Bethlehem Yieldable Arch.

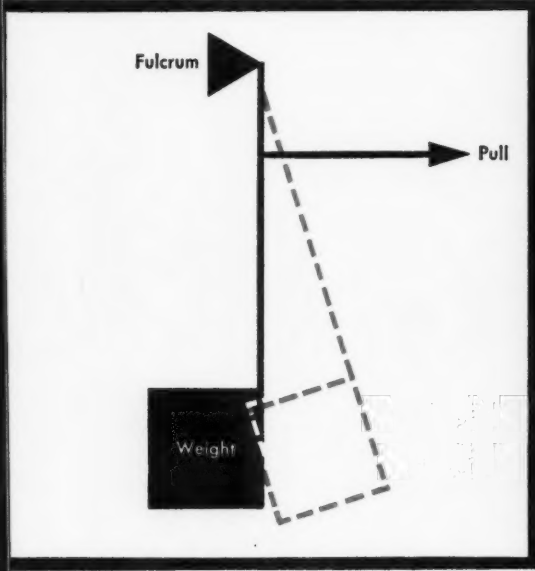
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

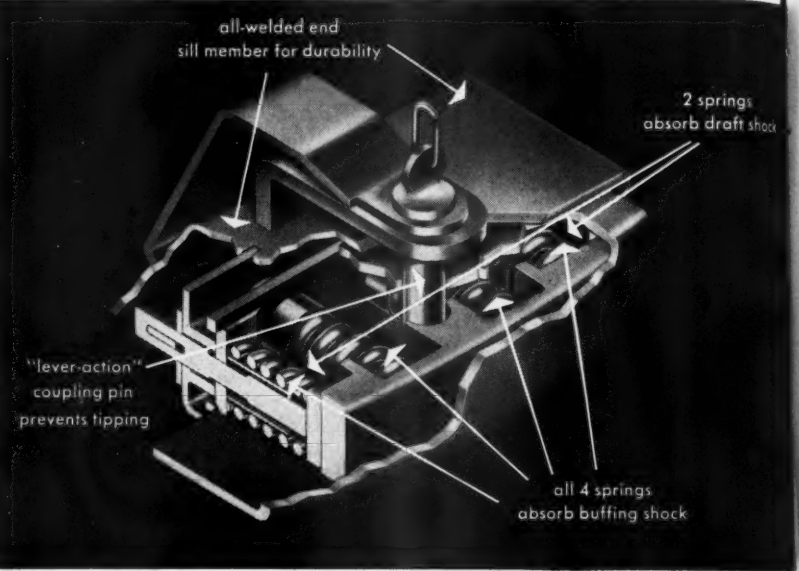
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

TAKE THE SHOCK OUT OF YOUR MINE CAR TRIPS!





acf HEAVY DUTY DOUBLE-ACTION SPRING BUMPER

√ Permits starting and hauling longer car trips!

√ Extends car life, lowers maintenance and repair costs!

√ Cannot tip, flatten or crush under severe draft or buffing force!

√ Proved in fifteen years of service on thousands of cars!

acf's exclusive spring bumper assembly soaks up draft and buffing shocks with ease, adds years of trouble-free life to mine car structure even in the hardest service! No other "shock absorber" works as well.

Available on all sizes and types of **acf** mine cars: end dump, rotary dump, or drop bottom. Fits neatly into the exclusive **acf** all-welded end sill member. Spring sizes varied to suit car design and capacity. A representative will be glad to explain the advantages and engineering features of the time-proven **acf** Double-Action Spring Bumper. Get in touch with your nearest **acf** sales office, or write Dept. MC-8 in New York.

Bulletin describing all types of acf Mine Cars available on request.

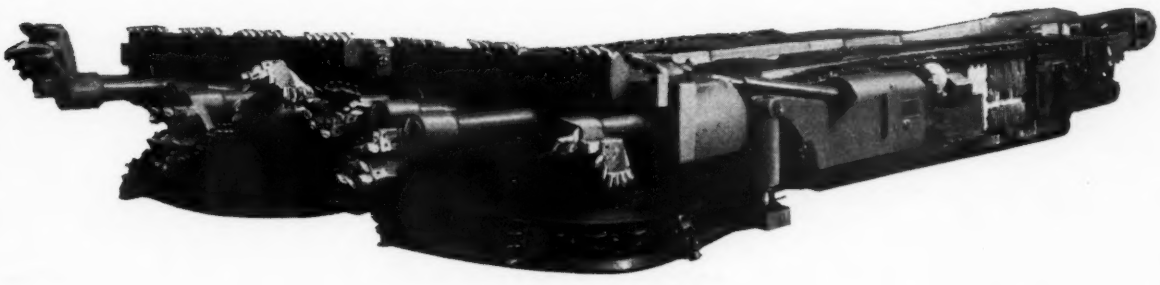
acf
AMERICAN CAR AND FOUNDRY
DIVISION OF ACF INDUSTRIES, INCORPORATED
750 THIRD AVENUE, NEW YORK 17, N.Y.

MINE CARS FOR CONSTANT HAULAGE

SALES OFFICES: New York • Chicago • Cleveland • Washington, D. C. • Philadelphia • San Francisco • St. Louis • Berwick, Pa. • Huntington, W. Va.

Makes a cut 14′7″ wide

All the benefits of fast, efficient, continuous mining... in seams as low as 28 inches



JEFFREY 86-A COLMOL

Low maintenance

Jeffrey 86-A "Colmol" is only 25¼-inches high... mines seams as low as 28 inches... makes a cut 14-feet 7-inches wide... gives good cleanup and smooth bottom.

Specially designed cutting and gathering chain carries coal to the center of Colmol, then up and onto the swinging discharge conveyor. It smooths off the cusps, even when the breaker-arm head is raised 8 inches for maximum mining height.

This powerful, compact Colmol advances with minimum maneuvering. Coal is broken from the face... not ripped or ground off. You get good overall screen consist, greater speed and efficiency. Colmol withstands the most severe mining conditions, operates with little noise or vibration.

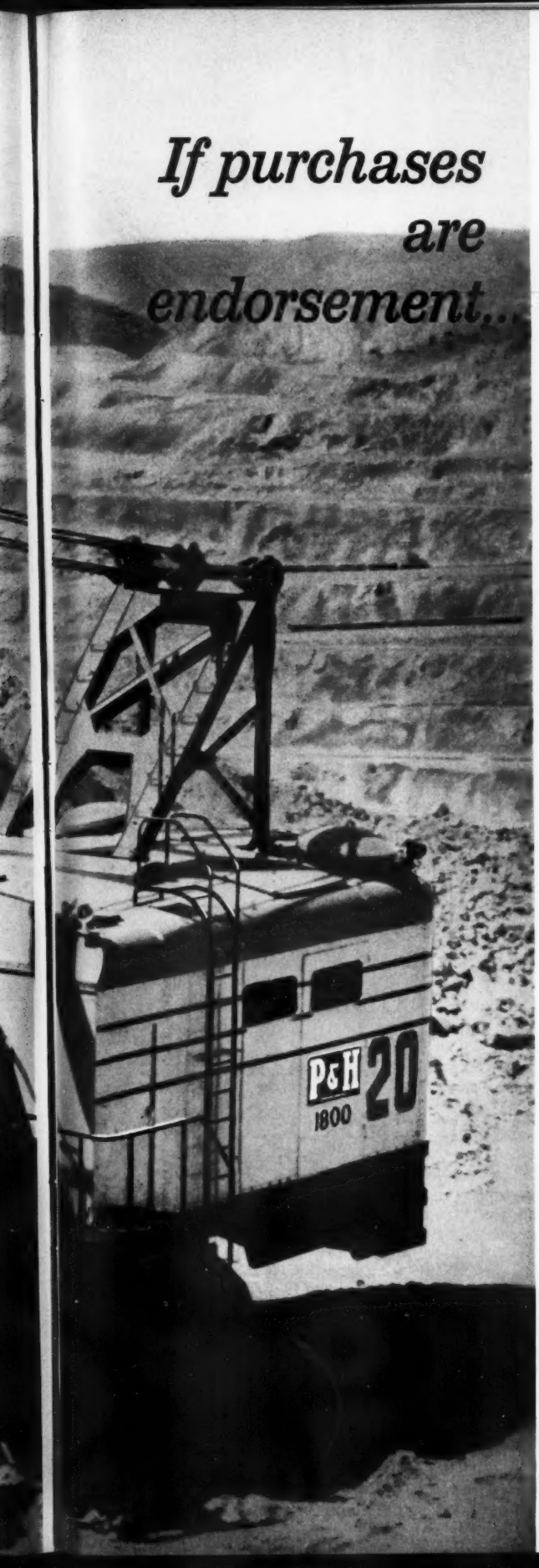
All adjustments are hydraulic, can be made instantly and accurately. Easily accessible parts simplify adjustment and servicing. Safety features provide extra protection for both personnel and machine.

For low seams... or seams up to 8 feet high
efficient, easy-going Jeffrey Colmols step up your production rate, cut operating and maintenance costs. Write for full details. The Jeffrey Manufacturing Company, 958 North Fourth Street, Columbus 16, Ohio.

JEFFREY

MINING • CONVEYING • PROCESSING EQUIPMENT...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING


P&H



P&H ELECTRICS ARE THE CHOICE OF SOUTHWEST'S MINES

P&H Electrics are setting new standards of production and maintenance economy in Arizona, New Mexico, Nevada and Utah iron and copper mines. For instance, today *three or more* P&H Electric Shovels are working at *each* of 7 out of Arizona's 8 operating copper mines!

The pattern of preference for P&H among copper mine operators is especially significant. Here, industry management must constantly concern itself with selection and performance of the big shovels—the "giants" that require a large capital investment and importantly influence tonnage costs.

Reasons why P&H Electrics are a popular choice among the southwest's mines include such P&H innovations as MAGNETORQUE® and ELECTRONIC CONTROL—each of these *exclusive* P&H features contribute mightily to steady day-in and day-out high production.

Also, P&H users get single source responsibility, as P&H designs, manufactures and applies all electric rotating equipment specifically for electric shovel service.

HARNISCHFEGER

Construction & Mining Division
Milwaukee 46, Wisconsin

P&H ELECTRIC SHOVEL LINE: 3½ through 10 cu. yd. capacities

BEHIND THE SCENES at the new electronically controlled, fully automatic factory for making Du Pont Electric Blasting Caps (both regular and delay).

Automatic loading and electronic controls give you Du Pont Electric Blasting Caps that are even more reliable, more uniform than before

Let us take you behind the scenes at the world's most modern blasting cap plant. Then, you'll see why Du Pont Electric Blasting Caps, both regular and delay, are years ahead in reliability, uniformity and dependability.

Any possibility of human error has been completely erased from this scene. Every step in the process, from automatically loading the shell (and inspecting it 3 times during loading alone), to applying the shielded shunt and paper band is controlled electronically.

This revolutionary approach means that every Du Pont electric blasting cap—regular or delay—*must* meet our rigid standards at *every step* or it will be automatically rejected by one of the dozens of electronically controlled "watchmen."

This elimination of the human equation means that all Du Pont Electric Blasting Caps are even more uniform, more reliable, more dependable than ever before.

And you get all these benefits at NO INCREASE IN COST. Call your Du Pont representative or write to E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

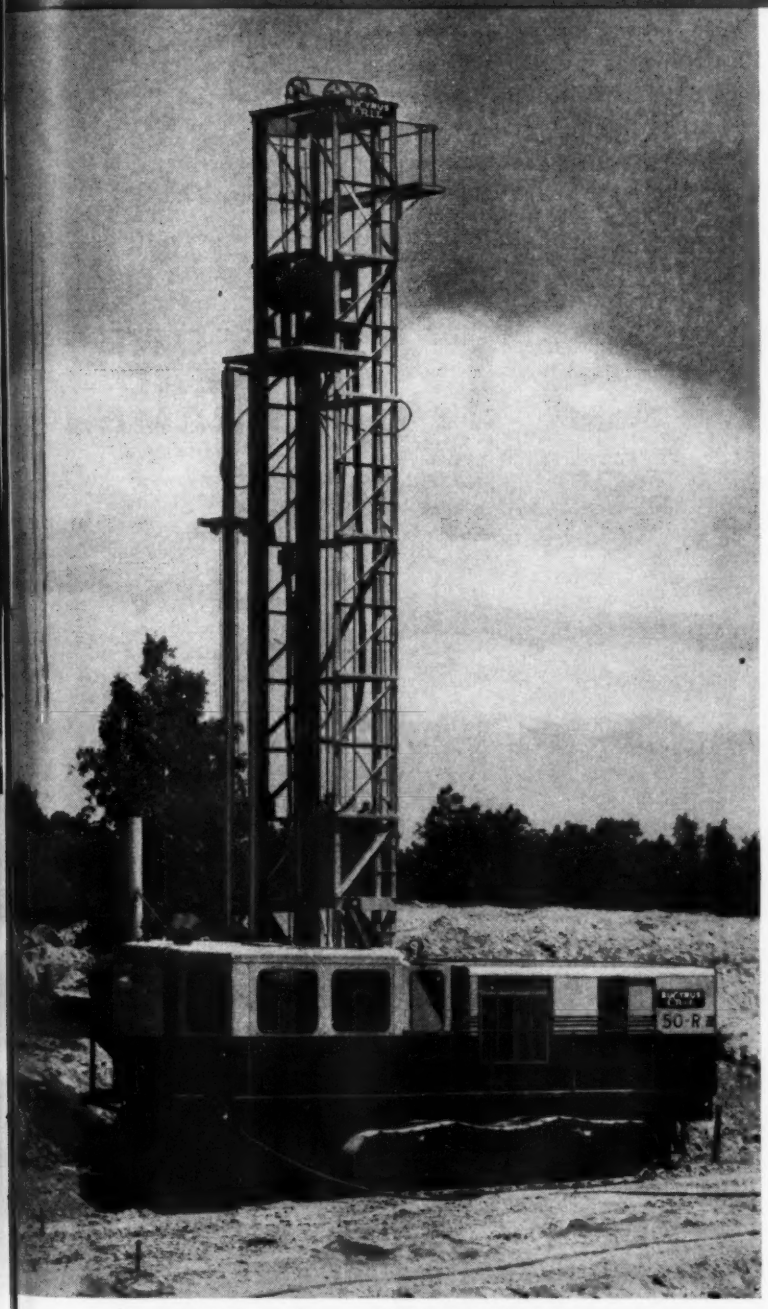
See our color motion picture of Ripple Rock, man's biggest non-atomic blast, at Booth 1210, American Mining Congress 1958 Mining Show, Sept. 22 to 25, San Francisco Civic Auditorium.

DU PONT BLASTING CAPS

DU PONT *Products of Du Pont Research*

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

BUCYRUS-ERIE ROTARIES Speed Blast Hole Drilling



A new drilling record was established at this large open pit coal mine in Indiana when the 50-R shown here was put into operation.

BUCYRUS-ERIE rotaries are increasing drilling footage at open pit mines everywhere. Their ability to put down hole fast results from an exclusive combination of features — variable drilling speed and variable down pressure.

For controlled speed, the Ward Leonard variable voltage system gives the operator smooth, instant command over rotation of the drill pipe. He can choose the most efficient speed for a given formation. To meet requirements, he can vary the speed without stopping the drilling operation.

In hard formations, maximum down pressure can be exerted on the bit while the drill pipe is turning slowly. This gives greatest possible penetration.

In soft formations, the operator can increase rotating speed substantially as he cuts down pressure. He can match pulldown force and rotation speed so tools do not advance faster than cuttings are removed. At the same time he keeps up enough air velocity to remove cuttings from the hole.

For the full story on Bucyrus-Erie rotaries, contact Bucyrus-Erie Company, South Milwaukee, Wis. Ask for illustrated bulletins on the 50-R (full-electric rig for drilling 9⅞ to 12¼-in. holes) and the 40-R (diesel or electric rig for drilling 6¾ to 9-in. holes).

71B58C

BUCYRUS ERIE

A Familiar Sign at Scenes of Progress

BUCYRUS-ERIE COMPANY • SOUTH MILWAUKEE, WISCONSIN

This impressive installation at Kiruna, Sweden, demonstrates a major benefit of ASEA Multi-Rope Friction Hoists: *low initial installation cost.*

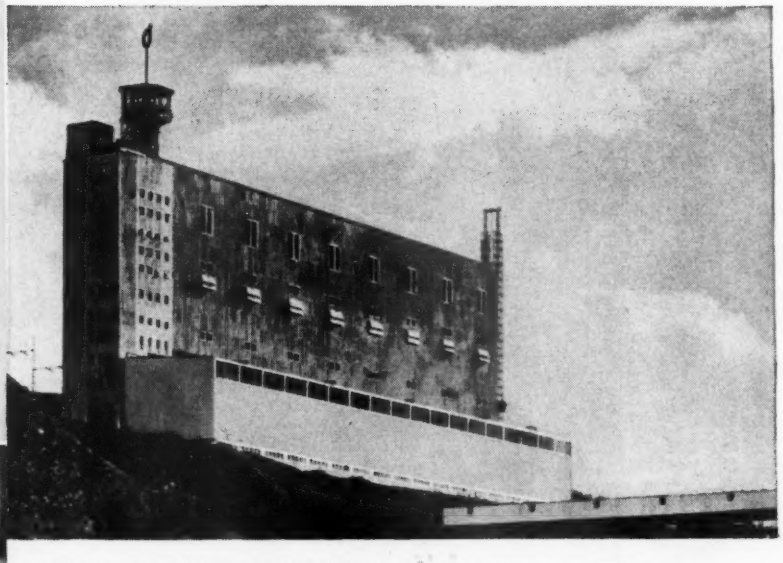
Each of these ASEA Hoists has a skipload of 22 tons and is designed for a depth of 1500 feet, maximum speed 2200 feet per minute.

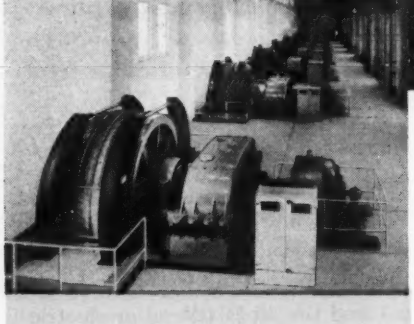
At Kiruna, as in mining operations throughout the world, ASEA Multi-Rope Hoists prove less costly to operate, safer, and they reduce rope wear.

In the U.S. these advantages may be seen in the ASEA installations of National Potash Co. and Cleveland Cliffs Iron Ore Co.

9 HOISTS IN ONE HEAD FRAME

Total capacity: 4600 tons per hour





FULLY AUTOMATIC, the ASEA Hoists at Kiruna eliminate the employment of hoist men.
At U.S. wage rates, assuming two-shift operation, this would mean a saving of about $30,000 yearly for each hoist!

Write for illustrated literature on ASEA Multi-Rope Friction-Drive Mine Hoists.

ASEA

World pioneer in electrical products for industry

U. S. Sales and Service:

ASEA ELECTRIC, INC.

formerly AROS ELECTRIC, INC.

500 FIFTH AVENUE, NEW YORK 36, N. Y.

NEW...FROM JOY LOW SEAM SHUTTLE CAR HAULS 4½ TONS

You can cut low seam haulage costs in *half* and speed up your entire operation with this completely new shuttle car. The reason for the 18-SC's greater capacity is its unique six-wheeled design. Joy engineers *added* another wheel to each side of the car, reduced the size of all wheel units, and hinged the car in the middle. The result is an extra-large conveyor, 6 feet wide and 27 feet long that empties 4½ tons in 27 seconds.

DRIVE WHEELS IN MIDDLE OF CAR—The two center wheels are used for the traction drive. Each wheel is driven independently by a 10 HP motor through a reducer and chain and sprocket, thus eliminating transmissions, torque converters and differentials.

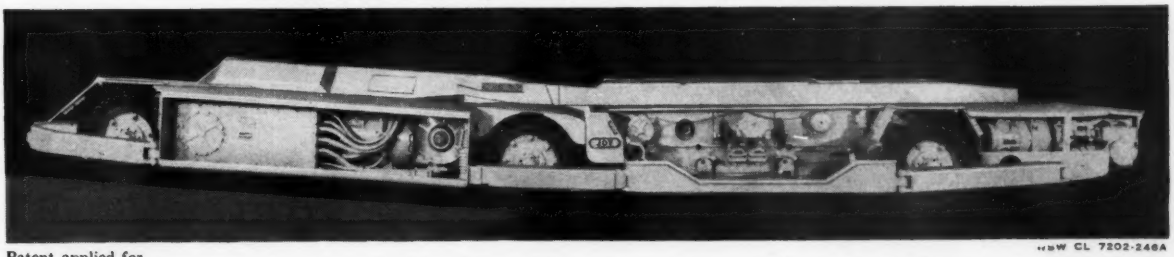
FOUR WHEEL STEERING—The two wheels at both ends of the car are steered hydraulically by twin boosters on each side of the car, and are controlled from the centrally located operator's station. The 18-SC has an inside turning radius of 11 feet.

ELIMINATION OF EXPENSIVE WHEEL UNITS—Since each of the six wheels is used *only* for steering or *only* for traction, the wheel units are extremely simple . . . easy and inexpensive to maintain.

UNIQUE SUSPENSION . . . NO AXLES . . . WHEELS HUG ROUGH BOTTOM—The four wheels used for steering are individually pivot-mounted to permit two wheels at one end to assume different elevations while the car bed remains level. This suspension, combined with the articulated mid-section, makes the 18-SC completely flexible throughout its length and width. Also, maximum ground clearance, since there is no axle running under the car.

Other models are available for work in higher seams. Talk to a Joy engineer. **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

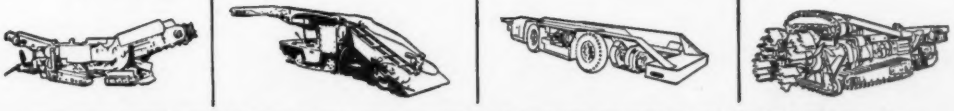
BENDS UP-AND-DOWN IN THE MIDDLE—For maximum flexibility under all conditions, the 18-SC is hinged across the width of the car, near the traction wheels. When climbing up and down small rises and depressions the car actually bends in the middle, keeping the wheels in contact with the ground at all times. This hinged design also permits running the discharge end of the car up a ramp when an elevated discharge is desired.



Patent applied for

CL 7202-246A

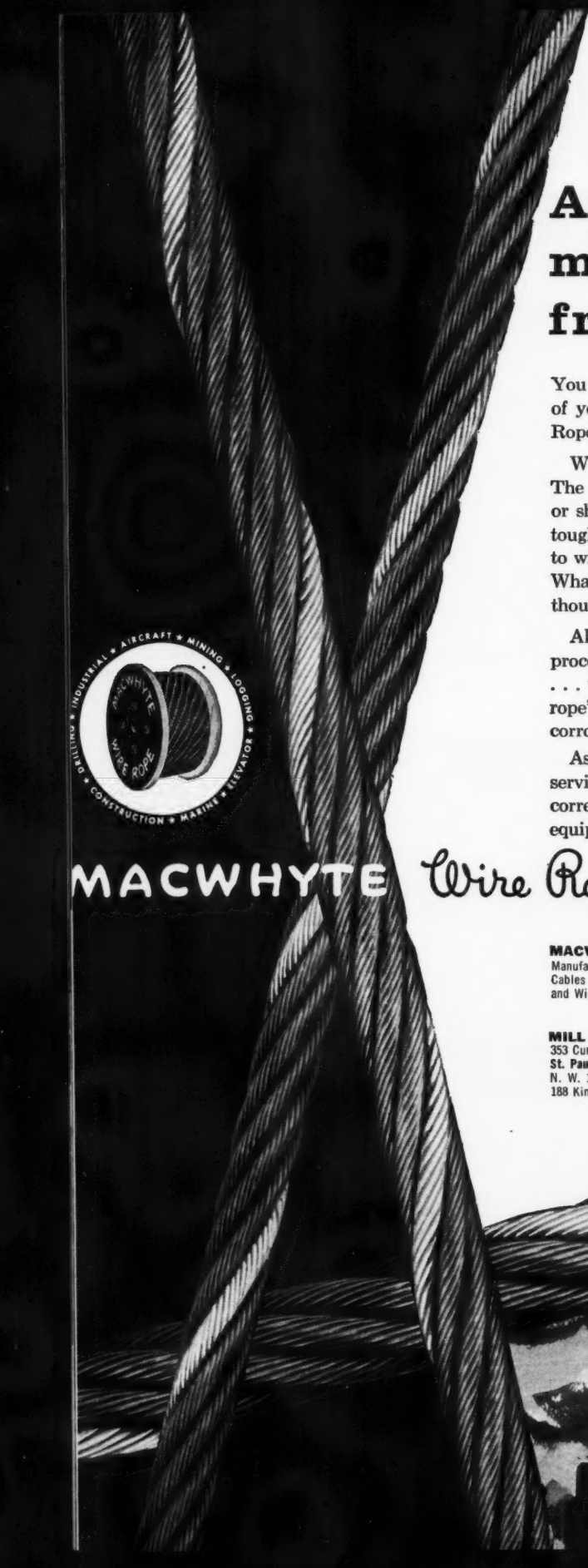
JOY...EQUIPMENT FOR MINING



CONTINUOUS MINERS, MOBILE LOADERS, SHUTTLE CARS, COAL CUTTERS, CUTTING MACHINE TRUCKS, COAL DRILLS, CONVEYORS, TIMBER SETTERS, SHUTTLE CAR ELEVATORS, BELT FEEDERS, FANS, BITS, PORTABLE BLOWERS, COMPRESSORS ROCK DRILLS, HOISTS, CORE DRILLS

AC

All Joy coal mining equipment, including the new 18-SC, is available with AC or DC.



Come and see us at the 1958 Mining Show, Booth 1117, for a lower yearly rope cost

Are you getting maximum life from your wire rope?

You can lengthen the service life — and lower the yearly cost — of your wire ropes by using the *correct* Whyte Strand Wire Rope for each piece of equipment.

What do we mean by correct? Well — all wire rope isn't alike. The demands of dragline service are different from those on scrapers or shovels. But whatever the requirements — no matter how tough the job — there's a Whyte Strand Rope specially designed to withstand the particular abuses of *each* kind of service. What's more, we'll be glad to recommend which of Macwhyte's thousand-and-one ropes is the *best* for *your* kind of job.

All Whyte Strand ropes are internally lubricated by a special process which individually coats every wire . . . every strand . . . with a tough, tenacious lubricant coating. This increases the rope's flexibility, reduces internal wear, and provides excellent corrosion resistance.

Ask your Macwhyte distributor for help in getting maximum service life from your wire rope. He'll be glad to give you a correct rope recommendation for each rope on every piece of your equipment. Don't guess when you can be sure. Call him today!

MACWHYTE Wire Rope COMPANY

MACWHYTE WIRE ROPE COMPANY, 2952 Fourteenth Avenue, Kenosha, Wisconsin
Manufacturers of Internally Lubricated PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal, Stainless Steel, Plastic Coated and Nylon Coated Wire Rope, and Wire Rope Assemblies. Special catalogs available.

MILL DEPOTS: New York 4, 35 Water St. • **Pittsburgh 36,** P. O. Box 10916, 353 Curry Hollow Road • **Detroit 3,** 75 Oakman Blvd. • **Chicago 6,** 228 S. Desplaines St. **St. Paul 14,** 2356 Hampden Ave. • **Ft. Worth 1,** P. O. Box 605 • **Portland 9,** 1603 N. W. 14th Ave. • **Seattle 4,** 87 Holgate St. • **San Francisco 7,** 188 King St. • **Los Angeles 33,** 185 South Myers Street.

"We bought 1 Tournatractor® to replace 2 crawlers"

says pit manager James W. MacDonald

At their Lynchburg Stone Division Pit in Concord, Va., Rockydale Quarries Corporation produces up to 2,000 tons of crushed limestone daily. To meet production requirements, 2 crawler-tractors were used on scattered maintenance assignments around the pit and plant. Since distances between the multiple-tractor jobs ranged up to ½ mi., the slow-moving crawlers lost valuable work-time when traveling job-to-job. What's more, track maintenance ran high because of travel distances over the abrasive footing.

So Rockydale Quarries looked for a more economical type of tractor. They found it in the rubber-tired LeTourneau-Westinghouse Tournatractor. Says pit manager James W. MacDonald, *"We bought 1 Tournatractor to replace 2 crawlers, and also to cut track repair costs. It's very successful... we like its speed and versatility."*

Tournatractor quickly clears blasted rocks from watery pit floor. Operator Rodney Arthur says, "Tournatractor is easy to operate. It's powerful, runs good and is *fast*. With a crawler it used to take me 16 min. to go from pit to plant... but with Tournatractor it takes only 2 or 3 min.!"

All-around handyman tool

Lynchburg Stone Division Pit uses their Tournatractor — equipped with 14'10" long Angledozer® blade — as an all-around handyman tool (note sketch). This speedy, rubber-tired tractor cleans-up after blasts and around shovels. It handles general dozing, moves wagon-drills on pit rim, assists stalled trucks, and maintains stockpile. When shovel at plant is down for repairs, Tournatractor takes over... pushes rocks from surge pile to hopper, to insure uninterrupted plant production. Rubber-tired tractor also is used to push-load pit's Handyman D Tournapull® scraper on stripping and road-building operations.

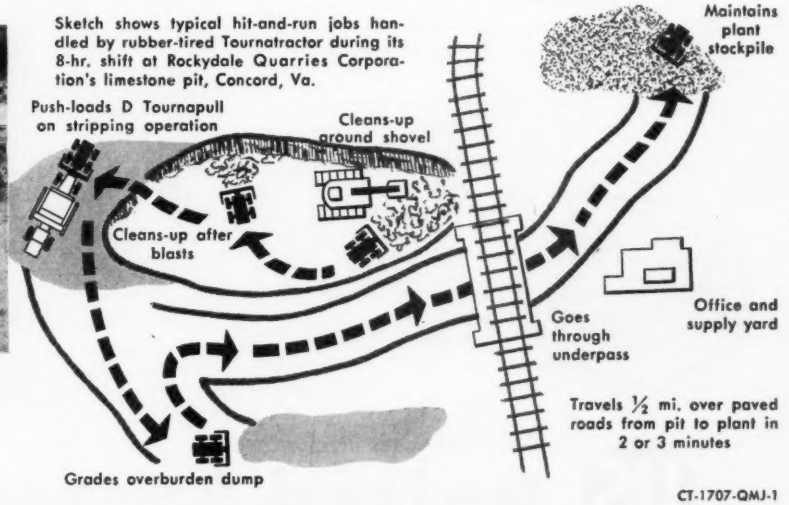
Commented pit foreman Jabe S. Ferguson Jr., "We're all strung out between quarry, plant, and stripping-ends on quarry rim. The Tournatractor hustles back and forth... works all over the place. It does a good job."

Try Tournatractor at your pit

If your pit operation is widely scattered or involves abrasive material, why not investigate rubber-tired LeTourneau-Westinghouse 210 hp Tournatractor? You'll find this speedy tractor completes scattered jobs faster, at lower cost. Let us arrange to demonstrate versatile Tournatractor at your pit. No obligation.

Between dozing assignments, 210 hp Tournatractor push-loads 7½-yd. D Tournapull (new "D" has 9-yd capacity) with red and blue clay overburden. Pit also owns a L-W Rear-Dump hauler which is easily interchanged with scraper... increases "D" prime-mover's usefulness.

Sketch shows typical hit-and-run jobs handled by rubber-tired Tournatractor during its 8-hr. shift at Rockydale Quarries Corporation's limestone pit, Concord, Va.



CT-1707-QMJ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

THE SPLICE OF LIFE

When you splice and reinsulate with Uskorona® and re-jacket with "D.R." splicing compound, you renew the life of the cable. *The entire splice will last as long as the cable.*

These entirely reliable tapes are:

- Extra-tight gripping, plus high in tensile strength.
- Resistant to acid, alkalies and moisture ... ideal for use on mining machine cables.
- Impossible to pinhole, so dangerous leaks can't occur.
- Absolutely waterproof.

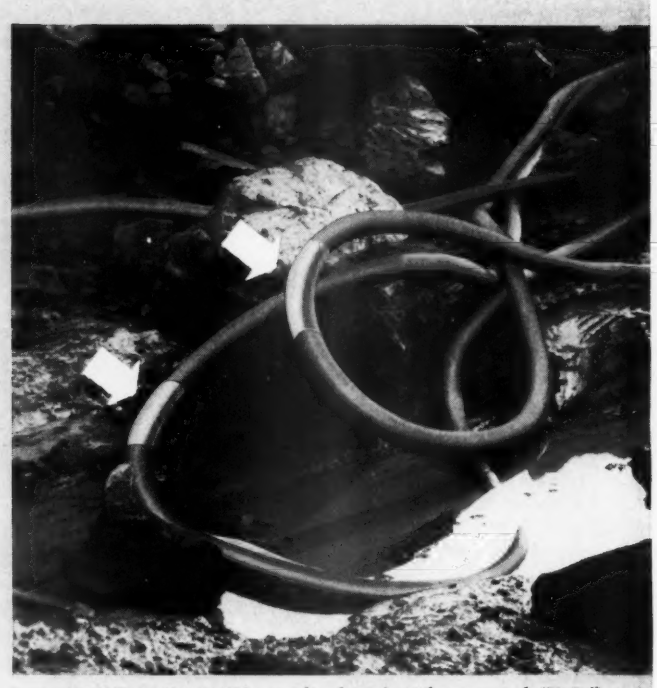
Uskorona exceeds A.S.T.M. specifications and can handle a wide range of electrical and general purpose jobs in mines. A complete line of mine tapes is available.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

"VISIT BOOTH 505 A.M.C."

US RUBBER **USKORONA SPLICING TAPE**



ABOVE GROUND. When spliced with Uskorona and "D.R." tapes, cables become perfect again. These splices restore the mechanical and dielectric quality of the cable, resist severe abrasion and exposure to moisture.

BELOW GROUND. Being run over by cable cars in coal mine can't hurt Uskorona splices protected by "D.R." splicing compound. They take this punishment many times a day.

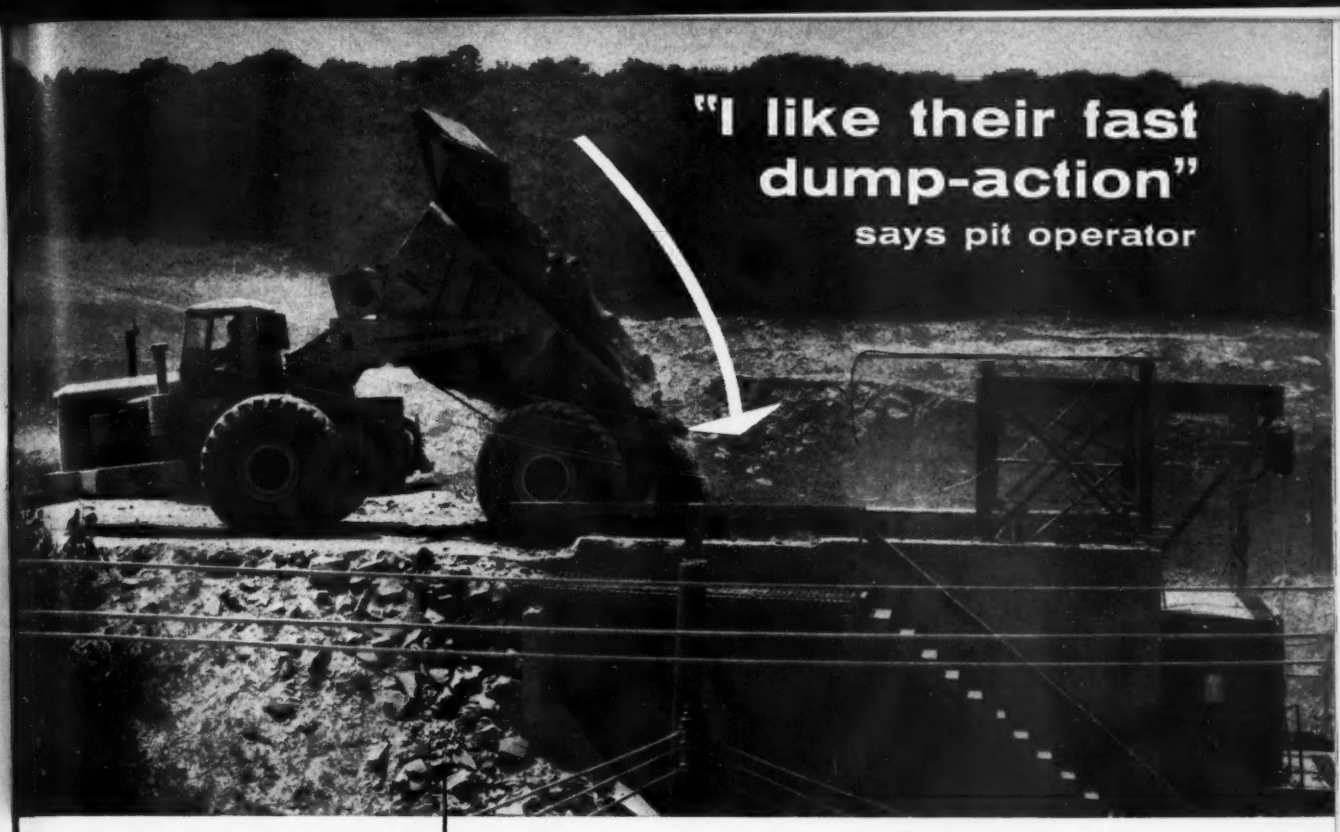
US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.



Tournapull operator dumps 22-ton load of rock into grizzly fast, and without spillage, because entire dump is under power-control. At full dump position, edge of bowl is low and behind rear wheels . . . material cannot roll forward to lodge against wheels, nor pile under rear end. Operator Gene Arsenault says, "These Rear-Dumps work and get around where a truck won't. They operate easy . . . we've had no trouble with the electrical system."

Material Service's Rear-Dump is loaded with 22 tons of rock in less than 3 min. Shovel operator does not have to take it slow and easy when loading Tournapull haulers. Unit's *all-steel* body — with sloping sides, and tri-level bottom—resists shock and crushing damage of loading heavy rock. Low, wide bowl permits dipper to swing-in and out *low* . . . for faster loading and minimum spillage.

At their East Granby, Connecticut pit, Materials Service, Inc. of Windsor Locks, produces 500,000 tons of crushed hard-trap rock per year. To help maintain production, two LeTourneau-Westinghouse C Tournapull® Rear-Dumps haul 80% of the rock from pit to crusher. Here's how these electric-control pivot-steer haulers perform:

Haul 22-ton loads up 11% grade

With 8 passes, the 2½-yd. shovel fills L-W Rear-Dumps with 22 tons of rock in 2 min. 51 sec. Units haul 1550′ from pit-floor to grizzly — including 500′ of 11% grade — in 3 min. 24 sec. At plant, Tournapull haulers make a tight U-turn, back up to grizzly, and dump their load in 12 sec. Rear-Dumps then return to shovel in 3 min. 4 sec., completing steep 3100′ cycle in 9 min. 31 sec.

Pleased with the performance of their Tournapull Rear-Dumps, owner Angelo Roncari says, "These units have done all we've expected of them. Best of all, I like their fast dump-action."

Electric-controls, simplified construction

Tournapull hauler's smooth, quick dump-action, is largely due to its electrical-control system and simplified construction. When operator flips toggle-switch on dash, point-of-action electric-hoist-motor is activated instantly. Body raises quickly to desired angle. There's no delay for hydraulic pressure build-up, no shock-loads — as with gravity dumping. And with only a few places to inspect and lubricate, maintenance time on rugged Rear-Dumps is greatly reduced.

See Rear-Dumps in action

To increase your production and lower maintenance costs, investigate modern Tournapull Rear-Dumps. There are 3 sizes: 11, 22, and 35 tons. Call or write for complete details, or let us show you these speedy haulers in action.

CR-1662-QMJ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

27 TON pull test shows 4-way expansion of O-B Shell and Plug!

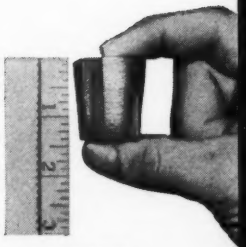
On the left, a plug from an O-B Bail-Type expansion unit. On the right, an identical plug after tensioning to 54,000 pounds — *6 times* the normal bolt load!

The test was made with a special bolt installed in a 1⅜ inch hole drilled in quartzite by an O-B customer operating a South African gold mine.

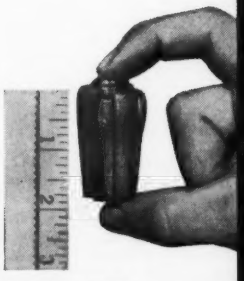
As shown in these unretouched pictures, the plug was compressed 22% and elongated over 30% by the tremendous pressures exerted against it. But, because those expansion pressures were distributed evenly four ways, reducing unit stresses to an absolute minimum, the O-B plug refused to break and release the bolt.

Four-way expansion is *another* reason why "they go up easy *and stay put!*"

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont.



PLUG BEFORE TEST



PLUG AFTER TEST

Ohio Brass

O B
SHELLS AND PLUGS

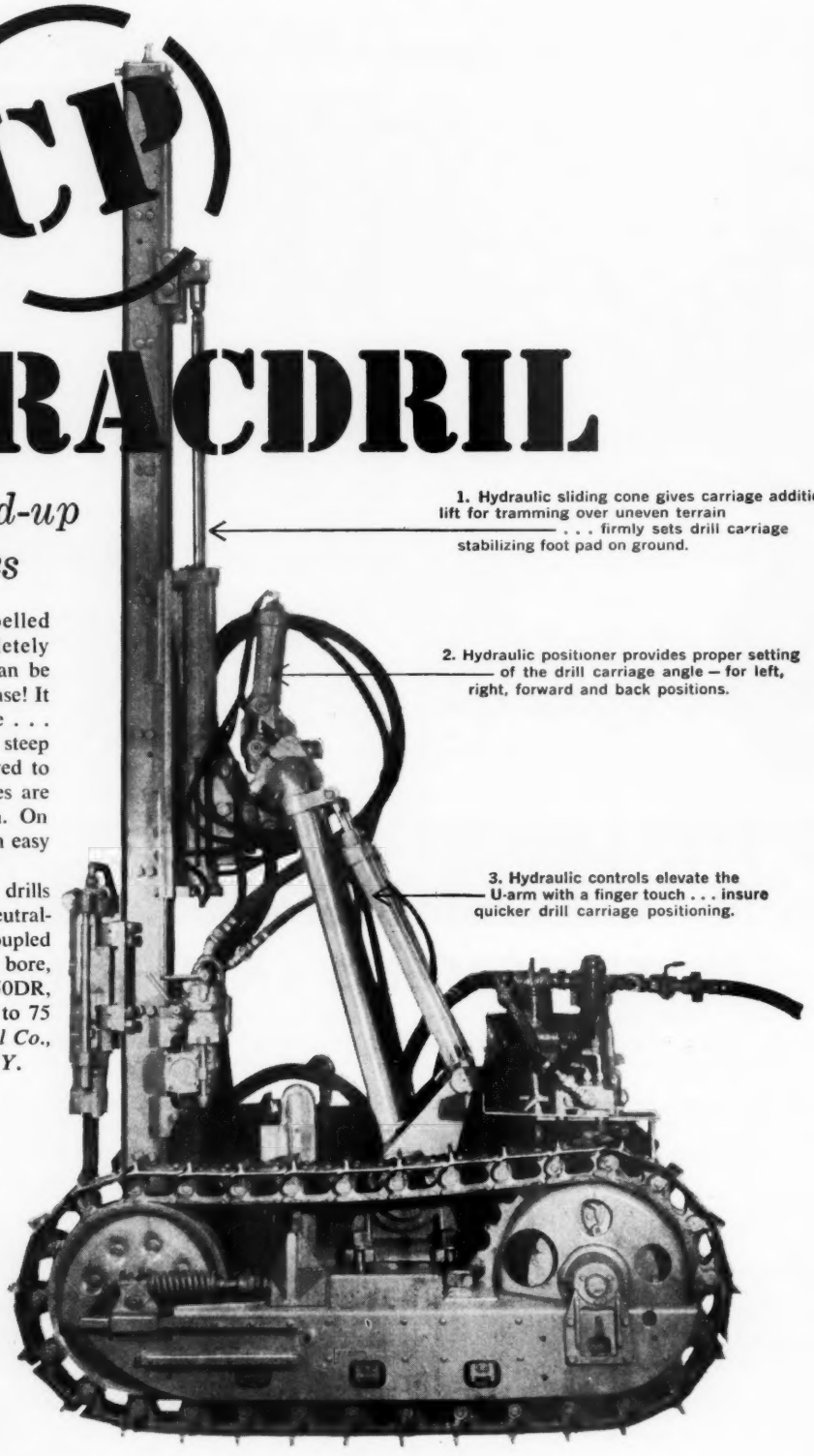
4827-M

CP TRACDRIL

has 3 speed-up features

This new G-800 self-propelled Tracdril provides a completely mobile drill mounting . . . can be "spotted" into position with ease! It takes uneven ground in stride . . . tows its own compressor up steep grades. With feed motor moved to rear of drill carriage, toe-holes are started only 9″ from bottom. On top-holes, drill controls stay in easy reach.

Two heavy-duty deep-hole drills now available with standard-neutral-reverse rotation for use with coupled steel: CP-400DR, 4″ cylinder bore, 2½″ holes to 50 feet; and CP-450DR, 4½″ cylinder bore, 3″ holes to 75 feet. *Chicago Pneumatic Tool Co., 8 East 44th St., N. Y. 17, N. Y.*



Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

CAT D8 TRACTOR-NO. 463 SCRAPER DIGS PROFITS OUT OF ALABAMA QUARRY

Cat D8 Tractor-No. 463 Scraper stripping overburden in mining operation near Tarrant, Ala. The haul averages 300 ft.

"I like the performance of our Caterpillar equipment," says John N. Cushman, general superintendent of the Dolcito Quarry Co., Tarrant, Ala.

Mr. Cushman is praising a Caterpillar team that is daily producing in excess of 2,000 tons of dolomite used for concrete aggregate, agricultural limestone, fluxing stone and rock dust.

A Caterpillar D8 Tractor with No. 463 Scraper strips overburden that ranges from 12 to 28 ft. thick. A Marion Back Hoe powered with a Cat D315 Engine assists in this function. The stone then is shot at a depth of about 50 ft., and a D7 pushes the rock to the quarry floor.

The D8-No. 463 combination is ideal where power and traction are needed for a short haul. The No. 463 Scraper, with all the fast, easy loading characteristics of LOWBOWL design, has a capacity of 18 cu. yd. struck, 25 cu. yd. heaped. It has straddle-mounted rear wheels with adjustable axles, high apron lift, protected cables—all the features that have made Caterpillar LOWBOWL Scrapers famous for high production.

The D8 packs 191 flywheel horsepower and 155 HP at the drawbar. It's tough, from track shoes hardened by a "water-quench" process to rugged diesel engine that uses low-cost fuels without fouling. And you have your choice of two models: torque converter drive and direct drive with the exclusive Caterpillar oil clutch.

Your Caterpillar Dealer has facts and figures showing how these big yellow machines can make a quarry operation more profitable. Ask for a demonstration.

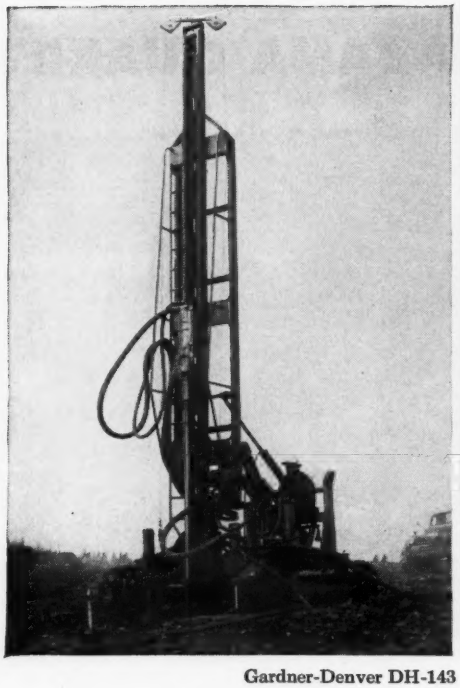
Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

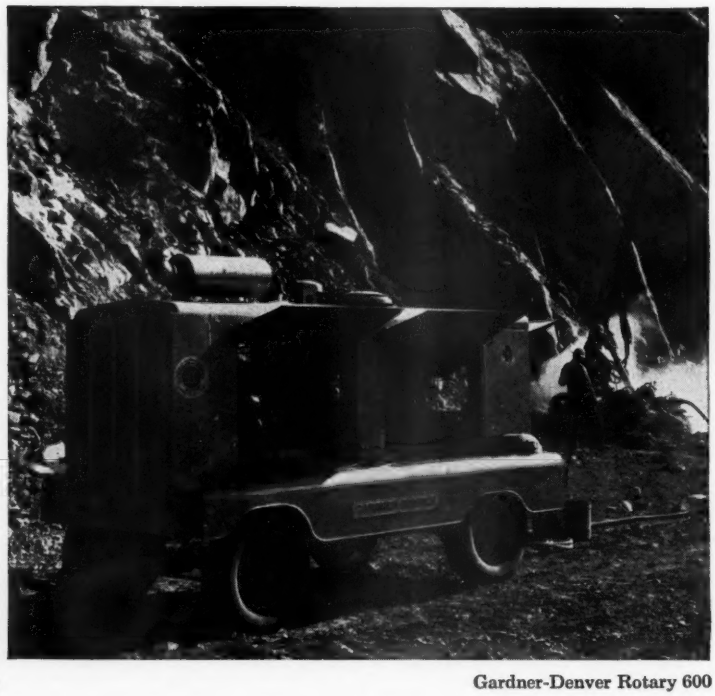
Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

FIND YOUR CATERPILLAR DEALER IN THE YELLOW PAGES

THE NO. 1 TRACTOR-SCRAPER COMBINATION



Gardner-Denver DH-143



Gardner-Denver Rotary 600

Pace Setters for Open Pit Production... Gardner-Denver Quality Drilling Equipment

For Blast Hole Drilling

SUPER 5½" DH143 CRAWLER DRILLS—self-propelled heavy-duty drill. Packs plenty of deep hole punch in all formations.

DELUXE "AIR TRAC"® CRAWLER DRILLS—all controls for drilling, drill positioning and crawler drive are centralized for ease of operation. Available with 4" or 4½" drills. Also "Air Trac" without remote controls.

NEW GARDNER-DENVER "MOLE-DRIL"*—for use with rotary rig. An in-the-hole drill in two models for drilling 4¾" and 6½" hole in hardest rock.

WAGON DRILLS—light- and heavy-duty for every need.

AUGER DRILLS—both wagon drills and "Air Tracs" can be equipped with rotary motor for auger drilling.

QUARRY DRILLING AND BROACHING DRILLS.

DEEP HOLE DRILLS, DRIFTERS AND SINKERS—a complete line.

AIR FEED LEG DRILLS—and air feed legs for sinker mounting.

DRILL FEEDS AND CONTROLS—to fit every drilling job.

For Quality Drill Steel . . .

SECTIONAL DRILL RODS—highest quality—shot-peened and carburized to stand down-the-hole gaff longer.

RING SEAL SHANKS—replaces old-type water swivel without adding additional length to drill.

COUPLINGS—extra long threads—made for longer drilling life.

For Air Power . . .

GARDNER-DENVER ROTARY PORTABLE COMPRESSORS—five models that offer water-oil cooling for all-weather operation, "THRIFTMETER"® fuel control, easy-to-get-at parts for speeding maintenance, clutch that eliminates cold-weather dry compressor starting. Sizes from 125 cfm. to 900 cfm.

STATIONARY AND SKID-MOUNTED COMPRESSORS—eight compact WB compressor packages that deliver continuous trouble-free performance. Water-cooled. Combination radiator-intercooler saves cooling water. Sizes from 1150 cfm. to 142 cfm.

For Building Your Own Jumbo . . .

JUMBO COMPONENTS—for tractor and truck mounting or building your own jumbo.

DRILL POSITIONERS—provide hydraulic swing and dump on end of booms for drill and feed positioning.

HYDRAULIC BOOMS—powered by creep-free hydraulic cylinders that operate at low pressures.

HYDRAULIC REMOTE CONTROLS—for remote-control operation of drills, feeds, drill positioners and booms from any centralized position.

Plus . . .

Bit Grinders • Centrifugal Pumps • Air Hoists • Drill Steel Shapers • Sump Pumps • Air Maintenance Tools Oil Forges • Air Line Oilers • Air Motors • Breakers Tampers

*Trade-Mark

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

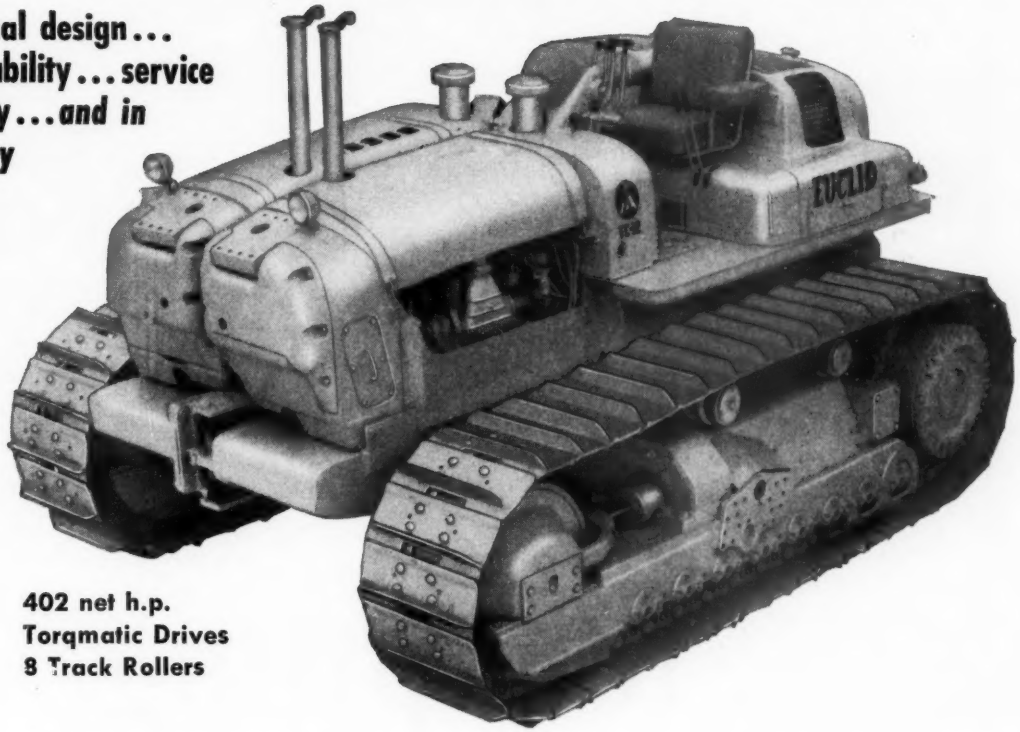
GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois
Export Division, 233 Broadway, New York 7, New York
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

New Series *Euclid TC-12* . . .

now even further ahead of other crawlers

in functional design . . . maneuverability . . . service accessibility . . . *and in work-ability*



402 net h.p.
Torqmatic Drives
8 Track Rollers

Ever since the TC-12 was introduced, there has been no question about its top performance ability —even on the toughest crawler jobs. Now with over 3 years of field experience on practically every kind of operation, major product improvements make the new TC-12 better than ever.

Powered by two engines, there's a total of 402 net horsepower delivered to the power train through separate Torqmatic Drives for each track. Big 27″ shoes and 8 rollers give the TC-12 good balance with or without heavy duty dozer blades and other mounted equipment. Bare weight of the tractor has been increased to 67,000 lbs. as a result of heavier construction and more rugged components throughout.

With independent track drives, there's no dead track drag when turning—maneuverability of the big TC-12 with its full power shift saves seconds on every cycle whether push loading scrapers, dozing or pulling big equipment. With unitized assembly, good design of component location and equipment mountings, this "Euc" provides easy accessibility for service and maintenance.

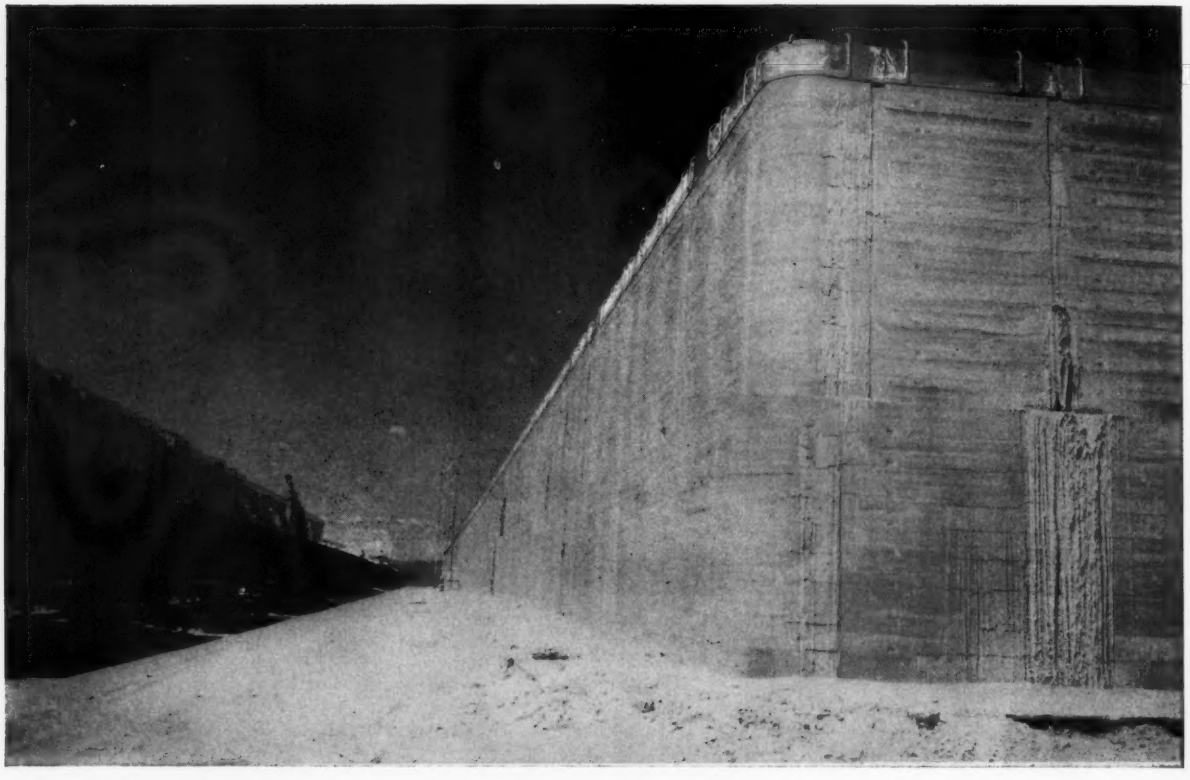
Have your Euclid dealer give you all the facts on the new TC-12 . . . you'll find its your best buy by far where big tractor performance is needed.

EUCLID DIVISION of GENERAL MOTORS, CLEVELAND 17, OHIO

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE



Stockpiling

...a continuing company policy established years ago

Stockpiling is a measure of service.

The government is stockpiling strategic materials for its long range defense program. Thus, it serves the citizenry. The producer of a raw material who as a company policy stockpiles also serves . . . serves its customers who in turn serve others by being able to count on a supply of the raw material in quantity.

The policy of Texas Gulf Sulphur Company has always been to stockpile . . . always producing *extra* for the future. In spite of the growing demands for the important basic material it produces—Sulphur . . . the company's policy has been to keep on hand stocks equal to about a year's normal demand. With such a supply, it can make shipments, routine or emergency, of any tonnage, at any time, by any method.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas

Sulphur Producing Units — **Newgulf, Texas** · **Moss Bluff, Texas** · **Spindletop, Texas** · **Worland, Wyoming**

Macks take up where other trucks leave off

And there's a dependable Mack for your every important hauling job!

Got big, rugged, truck-pounding off-highway jobs that demand the utmost in year-in, year-out truck stamina? They're made to order for the Mack L series . . . big, powerful units that range from 15 tonners up to the very largest.

Got on-and-off highway routes that demand clockwork dependability and cost-busting economy? From the 40,000-lb. GVW B-40 up to the 80,000-lb. GVW B-80's, Mack fields the units that have proved superior on every operation where profits ride on truck performance.

Need engines—gas- or Diesel-powered—transmissions, clutches, frames, suspensions, bogies and cabs that stand up to fast-moving shovels, rutted roads and slippery going? Mack makes them to the highest standards in the industry and assembles them in units engineered to your most exacting requirements.

Find out for yourself—soon—why many seasoned mine operators say that *two* Macks, properly used, can outwork, outlast and outearn *three* or more competitive units of equal capacity on tough jobs. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd., Toronto, Ont.

Be Our Guest at the Mining Show. See this 22½-ton LVX with rock body. See the new B-8136SX Mack Thermodyne® Diesel unit with six-wheel drive for on-and-off highway service where the going's next to impossible.

MACK

first name for

TRUCKS

IT'S PART OF THE LANGUAGE . . . BUILT LIKE A MACK

6342

Designed, Engineered and Built

for efficient, economical operation . . .

and to produce a better quality coal

your Roberts & Schaefer Plant

There's one *sure* way to get exactly what you want when you plan your new coal cleaning plant.

Call on Roberts & Schaefer engineers to make an analysis of your requirements. They will design a plant with the capacity and flexibility you need . . . a plant with cleaning facilities engineered specifically to prepare your coal to satisfy the demands of your market . . . a plant that will operate efficiently and economically. Many of the industry's most significant advances in plant design and coal preparation facilities were developed by Roberts & Schaefer.

Roberts & Schaefer provides a complete service covering initial process studies, design and engineering, installation and construction.

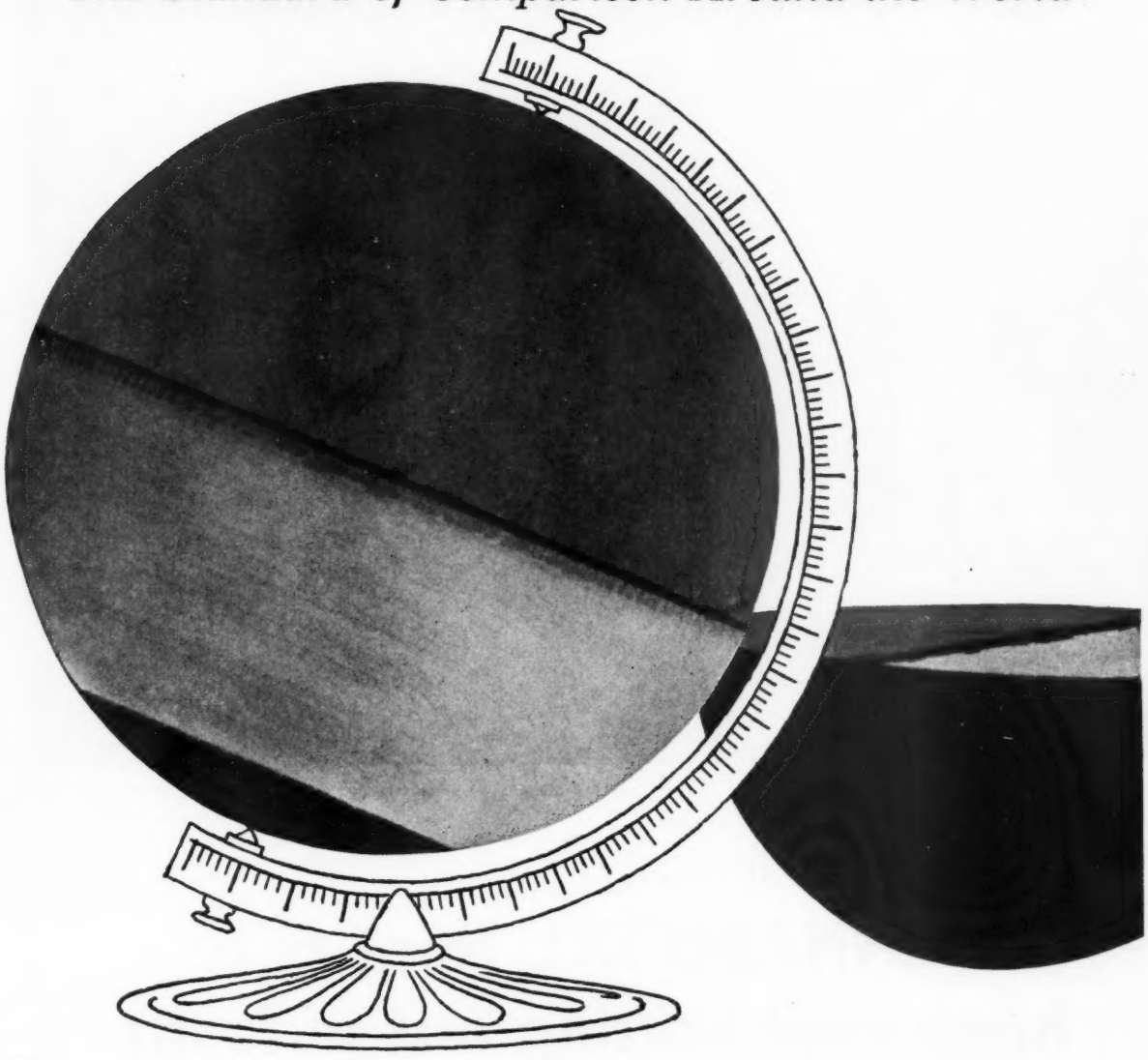
ENGINEERS & CONTRACTORS

ROBERTS & SCHAEFER *Company*

130 NORTH WELLS STREET, CHICAGO 6, ILLINOIS

NEW YORK 19, N.Y. • PITTSBURGH 22, PA. • HUNTINGTON 10, W. VA. • ST. PAUL 1, MINN.

The Standard of Comparison Around the World



hard and tough to the core...

Moly-Cop Grinding Balls have earned a reputation for long, economical service in the major mills of the world...and for good reason. The alloying, forging and heat treating by Sheffield assures an unvarying hardness and toughness to the core.

SHEFFIELD
ARMCO®
MOLY-COP
TRADE MARK
COPPER-MOLYBDENUM-ALLOY
Grinding Balls

SHEFFIELD DIVISION ARMCO STEEL CORPORATION SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA
EXPORT REPRESENTATIVES, THE ARMCO INTERNATIONAL CORPORATION, MIDDLETOWN, OHIO

Take full advantage of high powered drills with Kennametal FDC Roof Bits

No production delays here...

KENNAMETAL* Roof Bits keep roof bolting out in front

From actual performance records...

- 60 holes per shift drilled and pinned in laminated roof by one man
- 70 to 80 holes per shift drilled and pinned in solid sandstone by two men

Performance such as this is typical of what Kennametal FDC Roof Bits can do for you.

Modern drills make fast roof bolting possible, but the bits must be able to stand up under the added punishment. Kennametal FDC Roof Bits can take it, allowing you to take full advantage of high powered drills. Superior grades of Kennametal carbide withstand the severe shock and abrasion of high thrust and high torque. Roof Bolting Crews can work faster, allowing Face Crews to move in without delay. As a result, more coal is mined per shift, more money saved.

Let your Kennametal Representative help you select and actually test in your mine the Kennametal Bit designed to best match your operating conditions. Why not give him a call? You'll find his name listed in the Classified Section of your Telephone Directory under "Mining." Or, write KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania.

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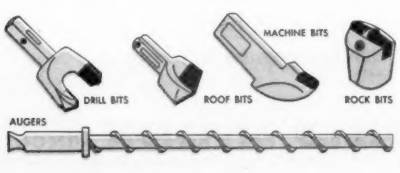

EDITORIALS

ROBERT W. VAN EVERA, Editor

AUGUST, 1958

MILESTONE OF PROGRESS

A substantial portion of this issue is devoted to the AMC Mining Show in San Francisco, September 22-25.

While we know that many of our readers will attend, there are also many who are under such pressure that they will find it difficult to leave their regular jobs during convention week. We strongly recommend, however, that mining companies send as many of their key men and "comers" as they possibly can. And we do not hesitate to say that the cost in time and travel expense will be many times repaid—in increased knowledge, in contacts with others who have similar problems, and in the broadened industry outlook which is promoted at all AMC conventions.

Whether you plan to be in San Francisco or not, study the program on pages 46 to 51. The titles of the talks alone give an indication of what industry leaders feel are among the most important topics in mining today. The authors and speakers are among the best informed authorities on their subjects (in case you want to contact them in the future), and the exhibit descriptions, pages 56 to 63, are a compendium of what's new in mining.

Yes, it will pay you to look over the convention section of this issue carefully—and to be in San Francisco September 22-25!

"IT WORKS—WHY CHANGE IT?"

In the mining industry there are as many companies looking for ways to reduce costs as there are companies that will succeed in perpetuating themselves as mineral producers, or as manufacturers of mining equipment and supplies. It is evident that competition and rising labor costs have placed increasing emphasis on the need to find more efficient ways to do the job. This is the objective of the "Value Analysis" program at General Electric Co.

Most companies have some kind of a cost reduction program—whether they call it "work simplification," "methods improvement," "efficiency engineering" or something else—and its scope will vary from company to company depending upon such factors as size, financial condition, type of operation, etc.

Lawrence D. Miles, manager of Value Analysis for General Electric, in a talk at the last Industrial Management Society Annual Clinic in Chicago, set forth some of his ideas on how to accomplish better cost reduction work. His thinking conforms with the principles underlying the policies of managers and executives in most corporations, but since he specializes in the cost reduction field, he makes a more searching analysis than most administrators have time to undertake.

Miles ably defends the name of the GE program —value analysis—by observing that value is based on function, not cost. His idea, of course, is to eliminate any consideration of the conventional or established cost of doing a job which might inhibit the search for a less costly method.

Cutting costs on a mineral extraction job is vastly different from that function in a manufacturing company like GE—where a few cents saved on one small component of a motor, for instance, might amount to many thousands of dollars in a year's time. But the six "roadblocks," which he says exist in every normal industrial manufacturing concern and which inhibit needed cost reductions, apply equally well to the mining industry. These are habits, attitudes, lack of information, wrong beliefs, lack of the idea, and temporary conditions.

Here is a little further explanation of what Miles had in mind when he talked about these roadblocks:

Habits—normally a commendable part of the makeup of all human beings, this roadblock had to be overcome before the coal industry laid aside the picks and shovels which had been used for generations, and installed mechanical equipment, all the way up to continuous miners.

Attitudes—hesitancy of a man to follow through on a plausible innovation because the boss or fellow workers call it a "hairbrained idea."

Lack of information—All too often the manufacturing industries have available products that could simplify parts of the mining job if only the operator were aware of them.

Wrong beliefs—These roadblocks exist in all people, including the decision-makers, and being honestly held—are difficult to cope with. Experience and study dispel many of these, but as we become more experienced the wrong beliefs which are not dispelled usually become more firmly fixed.

Lack of the idea—We can't always come up with a best solution at will, particularly when a decision has to be made quickly, but by deliberate concentration, creativity can be developed—in individuals as well as in organizations.

Temporary conditions—The pressure of getting a new mine or mill into production often requires that some phase of the job can not be worked out to optimum efficiency, and it may be months or years before it is corrected. The attitude "it works, why change it" can be a ticket to bankruptcy.

LONGWALL STOPING at The Radon Mine

By W. H. LOVE
Manager of Mines
and
P. M. LINDSTROM
Superintendent, Utah Operations
Hecla Mining Company

Using yieldable steel props, an adaptation of a coal mining method has solved a metal mining problem—safely and efficiently

THIS article covers the adaptation of a coal mining method to a metal mining problem. The ore body is flat-lying, has an average thickness of five ft, and is high-grade. The high value of the ore imposed the obvious requirement that recovery be complete. Clean mining of the ore is also important.

The longwall method, utilizing yieldable steel props, was selected and has given excellent results to date.

Two rows of steel props and cribs are used for roof support along a retreating longwall face. The back, or "roof", is allowed to cave as each successive face row of props is installed and each cave row of props is removed. Caving is fully controlled. The method is safe and efficient.

Geology and Development Described

The Radon mine is 35 miles southeast of Moab, Utah, in the north end of the Big Indian mining district. Hecla Mining Co. manages the property under an operating agreement with Radorock Resources Inc., of Salt Lake City, Utah.

The ore body is approximately 2150 ft long, 400 to 700 ft wide, and averages five ft in thickness. Thickness varies locally from one to eight ft. It strikes approximatey North 10 degrees West and dips seven degrees westerly. Uraninite is the predominant ore mineral and occurs principally in a hard arkose layer from two in. to eight ft thick, but commonly two to three ft thick. The enclosing mudstone, soft sandstone and conglomerate are in the bottom of the Chinle formation, in contact with the underlying Cutler formation. The mudstones rapidly disintegrate into mud as soon as wetted by drilling water, and the sandstones are friable and incompetent.

The mine was developed through a 690-ft, three-compartment shaft sunk at a point approximately in the center of the ore body and on its down-dip edge. A service incline was driven on ore to the up-dip limit of the ore body. Four strike drifts were driven the full length of the ore body from the service incline. (See figure 1).

A haulage crosscut was driven under the ore and parallel to the service incline. It is connected with each of the strike drifts by an ore transfer raise. The length of these vertical raises varies from 40 to 90 ft.

A ventilation incline was driven on ore and parallel to the service incline. A crossover was installed at each strike drift.

In addition to the main Radon ore body, two other small ore bodies have been developed and are being mined.

Development of the mine was essentially completed in late 1956 and the stoping operation begun. The mine produces 250 dry tons of ore per day with a total crew of approximately 50 men, including office and supervision.

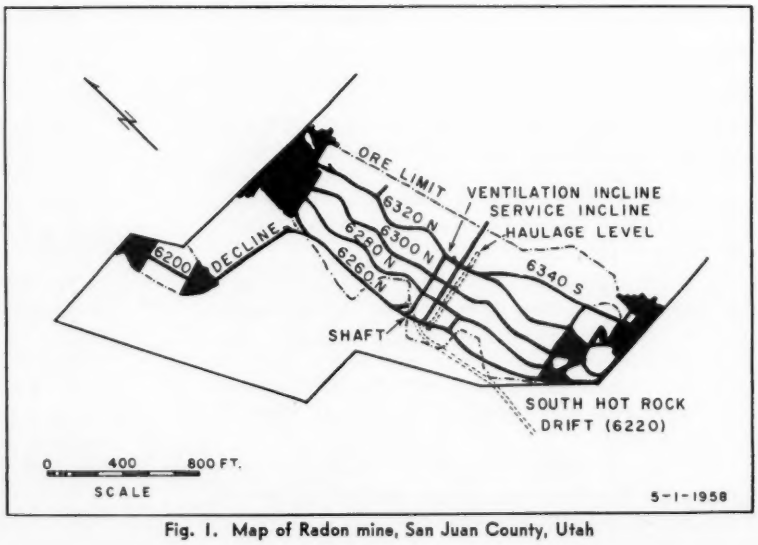

Fig. 1. Map of Radon mine, San Juan County, Utah

Mining Plan Based on Two Essentials

It was apparent in the early stages of the mine development that an efficient mining plan would embody two essentials. First—clean mining of the high-grade ore, and second—complete extraction of the ore body.

The average grade of the ore body is calculated as 0.72 percent U_3O_8, which is unusually high. Mining experience to date has substantiated the calculated grade; during 1957 and the first five months of 1958, the average grade of ore mined at the Radon was 0.78 percent U_3O_8.

At first glance, the solution to the mining problem at hand appeared to be an application of the room and pillar method. A great number of variations of room and pillar mining were studied, but none were found fully desirable. The uncertainty of full pillar recovery, plus dilution of the ore from a very weak roof, makes the method unattractive.

Methods utilizing waste for fill were studied. Mill tailings are, of course, not available, and even if they were, the effect of the water on the mudstone prevalent below and above the ore would be disastrous. Pneumatic or mechanical stowing of waste fill derived from surface quarrying was rejected because of the expense.

The natural solution to the problem seemed to be the application of the longwall method so commonly used in coal mines in Europe.

Early in the planning stages, a visit was made to a longwall coal mine in Pennsylvania and consultation was had with several experts on longwall mining. Help was obtained from Walter Herold of the Herold Manufacturing Co.; James J. Dowd of the U. S. Bureau of Mines; Earl Roecker of Bethlehem Steel; and Robert G. Peets of Bethlehem-Cornwall Corp. Peets was largely responsible for the installation of the longwall method utilizing steel supports at a manganese mine at Jalisco, Mex. This is the only known hard rock mine using the longwall system in an application similar to that offered by the Radon operation.

A thorough study of the application of longwall mining principles to this hard-rock mining problem convinced management that this method was the best available to achieve the necessary 100 percent extraction of the rich uranium ore in the Radon mine.

The longwall method also offered an opportunity of doing a good clean job of mining the high-grade ore. Clean mining has two distinct advantages. Although mining costs per ton are possibly higher than for the room and pillar method, the cost per pound of uranium produced is lower. In addition, the Atomic Energy Commission buying program offers substantial premiums for producing maximum grade ore.

Retreating Longwall System with Caving Chosen

Longwall mining can be broadly classified into "advancing" and "retreating" and can be further classified into "caving" or "packing." The Radon Mine is stoped by a retreating longwall system with caving.

An outstanding publication on longwall mining is "The Proceedings of the International Conference about Rock Pressures and Support in the Workings," a Belgian publication translated into English.

The pressure arch theory is most generally accepted for understanding and explaining roof control on longwall faces. Figure 2 is taken from Fritz Spruth's paper in the above reference. The higher beds in the back bridge over the mined area much as do the stones in a masonry arch. The weight is transmitted to the packed cave at one end of the arch and the other abutment rests on the unmined ore. The props are set under the relaxed core of the pressure arch.

It would be impossible to devise movable supports to support the load of the overlying rock to the surface. This load would be about 750 tons for each 14 sq ft, under the prevailing 700 ft of depth. Each prop in the

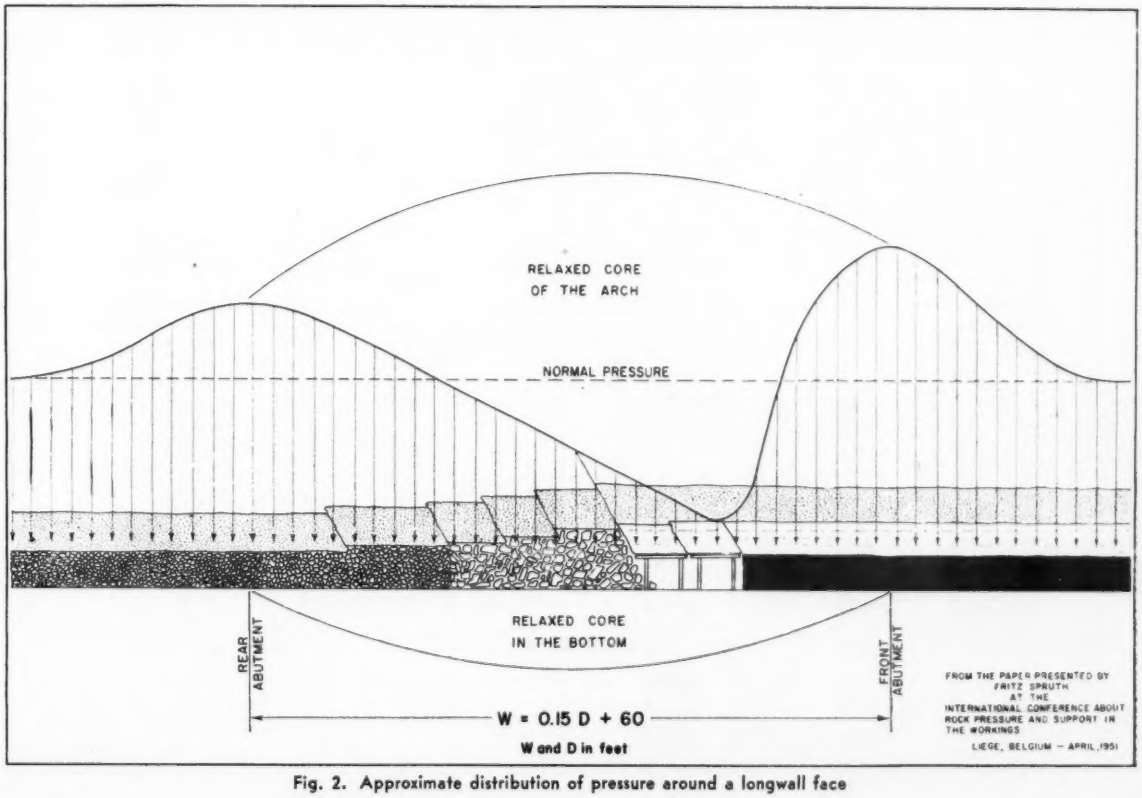

Fig. 2. Approximate distribution of pressure around a longwall face

Radon Mine, disregarding cribs, supports about 14 square feet of stope area. The two abutments relieve the pressure at the working face and make possible good roof control under the relaxed core of the pressure arch.

The decreased pressure in the relaxed core will equal the increased pressure on the abutments. There is an equal and opposite pressure in the bottom. Pressure on a pillar is intensified by two or more arch abutments, as shown in figure 3.

The British have determined from measurements in advancing longwall mining that the maximum span of the pressure arch in feet is roughly equal to 15 percent of the depth plus 60. In the case of the Radon mine, then, the span of the pressure arch is approximately 165 ft. (See figure 2).

The success of longwall mining depends to a large degree on control of the roof. Credit and appreciation is given to development abroad of improved steel roof supports with early and high load-bearing capacities and controlled yielding characteristics. Advantages of the steel support over wood props can be demonstrated for the Radon ore body, but might not prove feasible for another deposit where the dip is steep, the thickness is excessive, or the tonnage is too small for the capital investment required.

Becorit Steel Props Work Best

Extensible props have been used on a large scale in German coal mines since 1928 and several million are in use.

The Becorit "D" was selected because of its excellent characteristics and the first props were received in September, 1956.

A good prop should have an early-bearing characteristic. In other words, its rated load should be attained with as little roof subsidence as possible. The prop should yield in a uniform manner. Its weight should be minima with sufficient rigidity, and it should be capable of removal with ease and safety. Lastly, it must withstand the effect of blasting within three or four ft.

The Becorit prop is an early-bearing prop, which means that its full carrying load of 40 to 50 tons is reached at ⅜ in. of prop yield.

The three parts of the Becorit prop (figure 4) are; (1) an inner prop, sliding through (2) a locking device which is welded to (3), the hollow outer prop. The lock provides adjustment for length and permits setting and removal.

The prop adjusts from a collapsed height of 42 in. to a maximum extended height of 71 in. The weight of the complete prop assembly is 153 lbs. The cost of the prop delivered to the Radon mine is about $70.00.

The four prongs at the top are made especially for roof bars, which are commonly used in coal mines, but are not practicable in the Radon. The prongs are utilized in the Radon to keep a wooden friction block or cap piece in place against the roof.

For ore in thicknesses of over six ft, the props are lengthened by welding on a length of extra-heavy pipe to the bottom of the outer prop. Experience has shown that extensions should be limited to two ft. The prop may be extended by various wedging and jacking devices which will be described later.

Mechanics of the prop action are as follows: (See figure 5). To set the prop the wedge (3) in its maximum tilted position (13 degree slope) is driven into the lock with a hammer. The hard metal beads in the face of the inner prop (1) are forced slightly into the soft pressure block (grip shoe) (2) and are forced farther into it when the wedge is moved 13 degrees in the lock. The inner prop is pressed between the pressure block and the silicon aluminum friction liner (11) mounted on the back-up piece (10). When the prop load exceeds 15 to 20 tons the inner prop moves down and into the outer prop and forces the pressure block down.

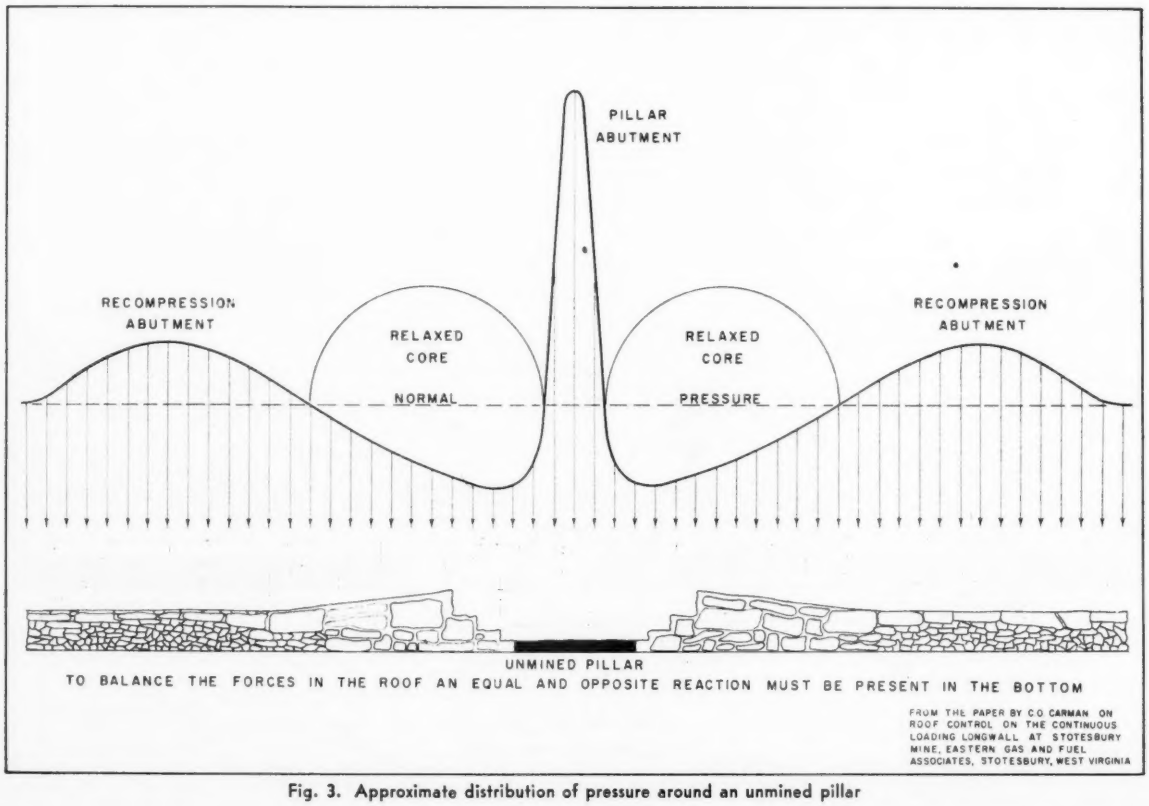

Fig. 3. Approximate distribution of pressure around an unmined pillar

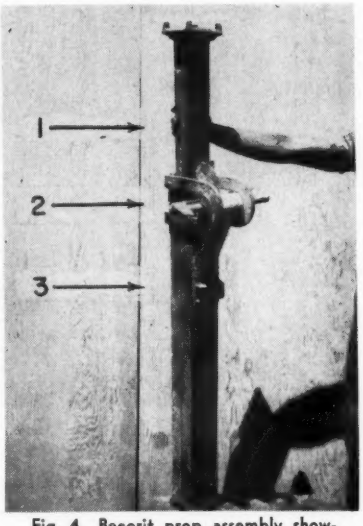

Fig. 4. Becorit prop assembly showing: (1) inner prop, (2) locking device and (3) hollow outer prop

As the pressure block comes down the wedge (3) and compensating piece (3a) are brought down from the tilted position to one degree below horizontal. This position of the wedge is reached after ⅜-in. movement when the pressure block touches the stop dog (6). The maximum extension of the spring steel straps (5) at this moment creates the maximum yielding resistance through the lock.

The inner prop has a slight taper throughout its length, so that a continuous yielding resistance of about 45 tons is achieved once the wedge is horizontal. Attrition of soft metal by the hard metal beads, along with the servo-action of the wedge makes the Becorit prop the first one which does not depend solely on friction.

Prop Setting Simple

A hitch for the prop is chopped with an axe. This is relatively easy in the soft sandstone or mudstone bottom. Next, the inner prop is raised to the roof by hand and the wedge is tapped lightly.

It is important that props be set with high initial loading to resist movement by blasting. The Neuhaus 6-ton ratchet-type mechanical setting device furnished by the manufacturer was not successful in the Radon Mine. A hydraulic method was devised using a 10-ton Porto-Power ram and hand pump.

A horseshoe-shaped collar two in. thick is placed around the inner prop and the ram is placed on the spring steel lock bands and under the collar. This method has sometimes resulted in failure of the weld on the spring steel on the back of the lock.

For setting props in lower heights a step for the ram welded to the side of the lower prop has proved very successful. Eventually all props will be set in this manner (figure 6).

Cribs Prove Effective

The crib base (figure 7) is made of four, 4-in. H sections braced and welded to a ½-in. plate 21 inches square. Four crib releases are bolted to two five-inch channels resting on top of the H columns. These crib releases have been used extensively abroad and are an excellent device for releasing pressure. Releases with an angle of 25 degrees were found much more difficult to remove than those with an angle of 34 degrees. Green oak, eight in. wide, random thickness (six inches is optimum), and two ft long, is placed criss-cross on top of the releases to the roof of the stope and wedged.

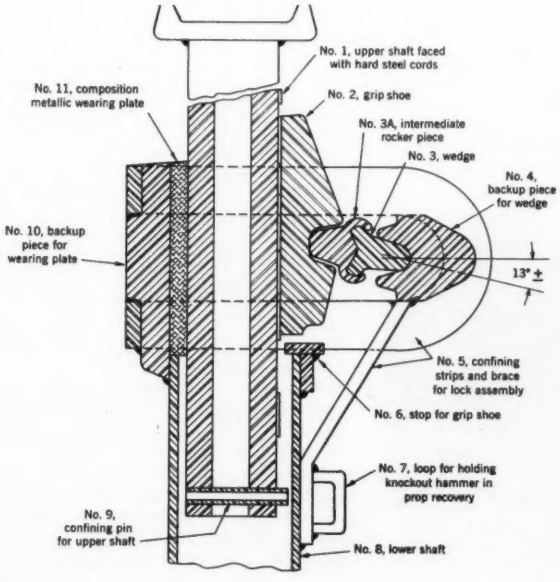

Fig. 5. Becorit prop cross-section

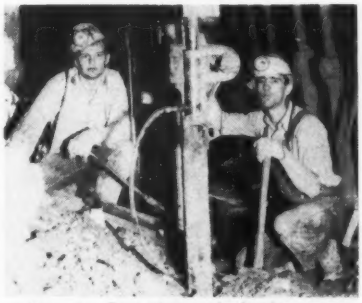

Fig. 6. Porto-Power hydraulic ram used for pre-loading prop during installation

Cribs have proved very effective in establishing a good solid support along the break line. They have good bearing in bottom and roof and the side thrust in the roof is reduced. The miners have a great deal of confidence in them. They are placed close to the front row of props to help support the prop lacing (described later).

Stoping commenced with steel props only (no cribs) at the northern limit of the ore body in the down-dip end in October, 1956. The stope outline in May, 1958 was shown on the map (figure 1). Caving was partially induced by blasting cut-off holes drilled just outside the prop line. Props were first spaced four ft apart in three rows, four ft betwen rows, giving a prop density of one prop for each 16 sq. ft. The third, or outer row, was later abandoned to relieve the pressure on the front two rows when the roof caved.

Cribs were not used until the first major fall occurred and a cave of the roof extending to the face resulted. At that time cribs were introduced and have since been used in every face. In addition, prop density has been reduced to about 14 sq ft per prop by placing the props 3½ ft apart in two rows four ft apart.

Fig. 7. Crib base, releases and oak cribbing

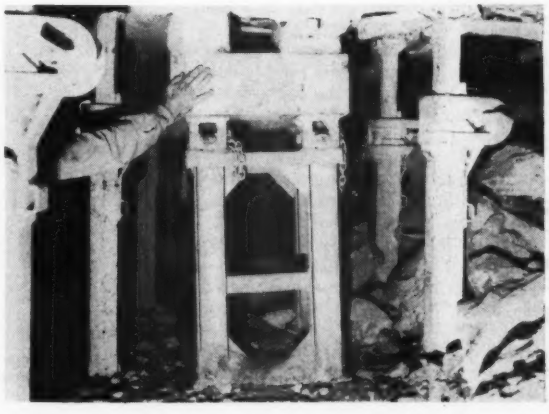

Fig. 8. Cribs and props offer some obstruction to the rock drills

Fig. 9. Fastening timber to props with steel straps

Mining Cycle Outlined

The cycle of mining is:

1. **Drill**
2. **Lace**
3. **Load and blast**
4. **Slush, load and tram**
5. **Move lacing**
6. **Clean up**
7. **Pull and reset props and cribs**

Drilling: Short telescopic air-feed legs are used because the cave is close to the face. Holes are drilled normal to the face and parallel to the roof and the bottom. Cribs and props offer some obstruction to the rock drills. (See Figure 8) Holes are carefully placed and bottomed an equal distance from the prop line. The longwall face is advanced four ft each round.

Lacing: Douglas fir four by eight-inch, in 12-ft, 14-ft and 16-ft timber is fastened to the props with steel straps. Two straps are used for each lacing timber (Figure 9). Reduction in the breakage of lacing was noted when the prop spacing was reduced from four to 3½ ft.

Loading and Blasting: About 40 holes along the face are loaded and blasted at a time. The hole next to the bottom is shot first, the bottom hole second, followed by successive holes to the roof. This reduces the amount of ore thrown over the top of the lacing. Blasting is with 1¼ by 16-in. powder, #6 caps and igniter cord.

Slushing, Loading and Tramming: A 20-hp, double-drum, remote-control slusher hoist is rock-bolted to the floor at the side of the drift about 75 to 100 ft from the longwall face. The slusher is moved when the face advances to within 15 ft of the slusher. A four-ft. slab round is taken out for a rope-way along the side of the drift. A 54-in. wide light-weight scraper bucket (Figure 10) travels 300 fpm.

Three-drum slushers have proved to be worthwhile when slushing directly into raises around a corner. Socketed cable has worked out best for the tail rope block fastening. Rock bolts in the drifts hold the angle blocks.

40 cu ft Granby cars are loaded with an Eimco mucker and trammed to the transfer raise with a three-ton locomotive.

Moving Lacing: After slushing is completed, the lacing is cut loose with an axe (or the "sealer",) dropped into piles and, if there is no room along the longwall, dragged by the slusher hoist to the closest drift. Any accidental spill of ore into the props must be hand-mucked to the scraper bucket.

Cleanup: The stope is cleaned by hand-shoveling and slushing before the props can be moved.

Pulling and Setting Props and Cribs: Several props are placed next to the face, four ft ahead of the front row, before props in the back row are pulled. Two men work on pulling and setting props. They fasten the slusher rope to the top of the prop, or to its middle, to pull it from the cave after the wedge has been released and the prop collapsed.

An eight-lb hammer has been found adequate to loosen the prop wedge. The prop robbing hammer furnished by the manufacturer has not been successful.

Caving usually follows the removal of each prop and is generally complete by the time all of the props in the line are moved.

Props are set to a string to insure a straight line for easier lacing and better caving.

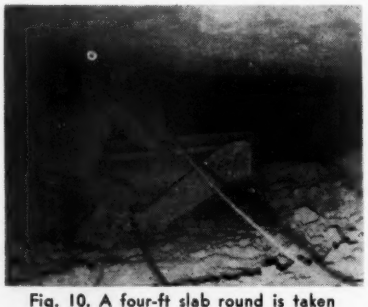

Fig. 10. A four-ft slab round is taken out for a rope-way along the side of the drift

Crib bases are moved by hand or, if partially caught in the cave, may be pulled with a slusher.

For the most successful roof control at the Radon mine, the following points are closely observed:

1. **Roof support is installed as soon as possible following blasting. This means slushing out and cleaning up the stope as rapidly as possible.**
2. **High prop setting load is achieved with a hydraulic ram.**
3. **A minimum thickness of wood should be used at the top of the prop.**
4. **Minimum mining height, governed by thickness of ore, aids in obtaining a quick cycle and in attaining early complete caving.**
5. **Large slabs tending to hang over the outer row of props are broken with a row of cut-off holes when necessary.**
6. **Only enough room for slushing is maintained between the face and first line of props. This distance is about seven to nine ft.**
7. **The cave line must be kept straight. No props or other ground support should be left beyond the outer prop row.**
8. **Two rows of props give sufficient room for drilling and provide better roof control than did three rows.**
9. **Cribs are very necessary and are spaced to keep the roof subsidence at a minimum.**
10. **Where necessary, increased support can be achieved by spacing props closer and by increasing the number of cribs in any area.**
11. **Holes are drilled flat as possible to make a smooth roof and bottom. Light shooting, using plenty of holes, helps keep the roof intact and displaces fewer props. Igniter cord is used for accurate timing of shots.**
12. **Drilling water, which softens the floor and allows the prop to be forced into the floor, is kept at a minimum by ditching it away from the props.**
13. **All faces are marked with spray can paint lines to outline the ore before the face is drilled. A Geiger counter and check sampling determine the cut-off limits.**

Full credit is given to the supervisors and crew whose attitude and adaptability have made this application profitable with safety for all concerned.

Prills of proper specification coated with 0.4 percent of an anticaking agent . . . two mixtures of oil . . . 60-grain Primacord . . . waterproof bags . . . these are some of the ingredients involved in a new system of blasting which Hanna Coal Co. believes provides a maximum degree of safety, highest efficiency and lowest cost for most blasting operations

The Hanna Ammonium Nitrate Blasting System

By JAMES HYSLOP
President, Hanna Coal Co.
Division of Consolidation Coal Co.

FROM 1940 to 1957 overburden blasting at Hanna Coal Co. was done through the use of a liquid oxygen-lamp black explosive. This material was used because of its high efficiency, low cost and excellent safety record. In considering the use of ammonium nitrate as an explosive, it was necessary to compare its performance, cost and safety with liquid oxygen explosives rather than fixed explosives—the cost of which, in Hanna's case, would have been twice as great as that of liquid oxygen-lamp black.

17 Years Without an Accident

One of the attractive features of liquid oxygen blasting lays in the fact that after a charge has been in a blast hole for a few hours it becomes inert, thus eliminating the danger of explosion accidents resulting from a shovel digging into an unfired charge. The hazards of handling this explosive were believed to be well understood and for 17 years Hanna fired up to 1,000,000 lb of explosive per month without a single accident. Then the coal firm had the unfortunate experience of an accidental explosion while charging a blast hole which resulted in the death of four men. The exact cause of this blast could not be definitely determined. This meant that the company could not be absolutely sure of eliminating the possibility of other accidents of a similar nature—notwithstanding the fact that management did adopt every safety precaution which seemed prudent after the accident.

The company, therefore, inaugurated a study of all practical blasting systems and proceeded to carry on an extensive experimental blasting program. In outlining this program the objective was to find a blasting method which would give maximum safety, adequate fragmentation and displacement of the rock overburden and low cost.

In the early part of his coal mining career, James Hyslop worked as electrician, mechanic, shop foreman, assistant mine superintendent, mine superintendent and chief engineer. This varied experience proved valuable when he was made assistant to the president of Walter Bledsoe & Co. in 1935, and later manager of operations. Since 1940 he has been associated with Hanna Coal Co., serving successively as general manager, vice president, executive vice president, and president. A progressive mining man, Hyslop was chiefly responsible for the extensive, scientific investigation of the whole problem of ammonium nitrate blasting that is described in this article.

Ammonium Nitrate Mixture Required High Explosive Primer

Prilled clay-coated ammonium nitrate of fertilizer grade was being extensively used for blasting and Hanna experimented with the application of this material to its work. Results were achieved which looked interesting but the performance of this explosive appeared somewhat erratic. Furthermore, the use of clay-coated ammonium nitrate, as practiced throughout the industry, required the use of a priming charge of dynamite or other similar high explosive, plus the use of additional booster charges of high explosive at frequent intervals throughout the charge. The ammonium nitrate mixture with carbon or hydrocarbon materials was too insensitive to detonation to permit its use without a high explosive primer and this low sensitivity, together with other characteristics, resulted in the dying out of the blast in long charges if booster charges of high explosive were not located throughout the charge at intervals sufficiently close to maintain the detonation.

To Hanna this situation presented

serious handicaps. In the first place, the presence of dynamite or similar explosives for primers and boosters meant that the shovel operator would always have to face the possibility of digging into a misfire which might be set off by impact. While the danger from stomach ulcers resulting from this tension may be more serious than the danger from a flying rock, the hazard is a real one and cannot be ignored, particularly at a large operation where millions of pounds of explosives are being used annually and where blasting is done by a great many different people. Second, the fact that a blast in explosives of this type is not self-propagating is an indication that there is likely to be a wide variation of efficiency in blasting operations and this, in turn, means a corresponding loss of efficiency in digging operations due to inadequate blasting. In the third place, primers and boosters are expensive.

The firm's experimental work, which had all been done in the field, failed to produce reliable data that would enable results to be accurately evaluated. Fortunately, in its organization Hanna has quite a number of people with imagination and initiative, and when they turned these talents to the development of a satisfactory ammonium nitrate blasting system, a great variety of ideas and experimentation developed. Obviously, the way to eliminate the primer booster problem was to concoct a mixture of ammonium nitrate and something else which would impart the necessary sensitivity and power for blasting. Management found that it was not too difficult to produce mixtures that would eliminate the need for primers and boosters, but there was no guarantee of maximum safety.

Attaching the multi-wrapped Primacord to the priming charge

Scientific Investigation Yields Practical Blasting System

Hanna was amazed at the paucity of reliable data on the use of ammonium nitrate as an explosive. Everyone knew that a mixture of oil and prilled clay-coated ammonium nitrate would make an explosive, but no one seemed to know how much oil should be used —how it should be applied, or to have any accurate idea of the kind and amount of work such an explosive would perform. After consulting with all of its own men who were working on the project, and after laying the problem before expert consultants outside of its organization, management came to the decision that the only safe and sane way to work on the project was to inaugurate an extensive, expensive, scientific investigation of the whole problem of ammonium nitrate blasting. It seemed obvious that something more reliable than visual observation of field blasting was needed in order to develop a satisfactory blasting system. Obviously scientific data was needed rather than impressions and intuition. The company, therefore, decided to go forward with a scientific program and employed Combustion and Explosives Research, Inc., and through them Arthur D. Little, Inc.

This program has gone on for almost two years now and the results it has produced have verified Hanna's original analysis of the situation. The industry has displayed a great deal of interest in the work being done and the company regrets that it was necessary to refrain from publicizing the results until this time. The firm's reluctance to disclose the results of its efforts has been due, not only to the patent problems involved, but also because it has taken all this time to produce the data needed and to apply this data to a practical blasting system. It is not feasible to give a full report of the research, but this article will briefly describe one of the blasting systems which has been developed —one which the coal firm believes provides the maximum degree of safety, the highest efficiency and lowest cost for most blasting operations.

Coating Material Affects Explosive Effectiveness

Hanna's research work has explained many of the phenomena which it observed in field experimentation, and the following is a brief outline of some of the more important of these factors:

1. The clay coating customarily applied to the prills in order to prevent caking has a deleterious affect on the sensitivity and power in blasting. The amount of inert material commonly used for this purpose varies from two to five percent and this amount of inert material makes it difficult, if not impossible, to propagate an explosion through a charge without the use of both primers and boosters.

2. The physical character of the prills, such as size, density, hardness, porosity and moisture content has a very important influence on the effectiveness of the prills when used for blasting.

3. Inert material may be used to coat the prills without adversely affecting explosive effectiveness provided the amount of the coating material is limited to about 0.4 percent, or about ten percent of the amount usually applied to prevent caking. It was found also that inert material in the amount suggested here is just as adequate to prevent caking as the much larger amount commonly applied for that purpose.

4. The percentage of oil mixed with the ammonium nitrate has a very important effect in blasting—maximum power can be obtained only if the oil present at the time of the blast is approximately six percent. Serious loss of power occurs if the amount of oil is substantially above or below this figure. On the other hand, maximum sensitivity is achieved if the oil content is limited to approximately two percent.

The method of mixing the ammonium nitrate and oil is important and must be done in such a way as to achieve and maintain uniform distribution of the oil.

5. If the oil-ammonium nitrate mixture is properly controlled and if the prills are of the right character, and if the inert coating is limited to the right kind and quality, the charge can be detonated with 60 grain, or smaller, Primacord.

Two Mixtures of Oil Used

As a result of the study of these and other perhaps lesser important factors, Hanna has developed a system of blasting which it believes to be superior to any other system it has tried. This system consists of using prills of proper specification coated with 0.4 percent of an anticaking agent. Two mixtures of oil are used. A relatively small quantity of a two percent mixture is used as a priming charge. One convenient way of applying such a priming charge is to make up cartridges of the two percent mixture. These cartridges need not be as large as the 40-lb units which the company usually uses in the main charge. For an 8-in. hole, 20 or 30 lb, or even less, of the two percent material is adequate. To this two percent priming cartridge the Primacord is attached. Any size Primacord may be used—Hanna uses a 60-grain size. However, in order to assure detonation and to assure a detonation of a high order which will efficiently impart a high rate detonation to the main charge, about six turns of the small Primacord is wrapped around the center of the bag, these turns being pulled tight so as to make a waist in the bag, giving the Primacord more intimate contact with the explosive mixture. Water has a serious desensitizing effect on all ammonium nitrate-oil mixtures and if water is present in the blast holes it is important that the primer, at least, be contained in a water-proof bag. Hanna has developed such a bag which is quite inexpensive.

If the whole charge were composed of a two percent mixture, an explosion would, of course, be achieved, but the power of the blast would be about 25 percent below the maximum that could be realized if the mixture of six percent were used in the main charge. Where deck loading is necessary, only one line of small Primacord is used down the hole, fastened to the primer in the lower deck. The primers for the upper decks are wrapped with a short piece of Primacord in the same manner as has already been described. A loop is created through which the down line in the hole is threaded. In this way any number of decks can be detonated from a single line of small Primacord.

It is possible to modify this system by using a six percent mixture exclusively and in many cases this can be satisfactorily detonated. However, the reliability of the blasting is reduced and if dampness or other adverse factors are present a misfire or inefficient blast is likely to ensue.

One of the striking features of this system is that practically no smoke is made in blasting and it is believed that smoke is an important indicator of the efficiency of an ammonium nitrate-oil mixture blast.

This system and modifications of it have also been applied to blasting in small diameter holes. In the company's limestone quarry four-in. holes have been blasted by this method and test work indicates that the diameter can be reduced to at least one-in. and still obtain satisfactory results.

No problem is experienced in connection with bag to bag propagation or with the blast dying out before it has consumed a large charge. The speed of the blast in an 8-in. hole is 13,000 fps.

Results of Extensive Tests

Hanna has tested the power of its system with ballistics mortar tests as well as other methods and the results of these tests indicate that the two percent mixture produces a blast about 94 percent as powerful as TNT; the six percent mixture gives a power of about 123 percent of TNT; a 60 percent dynamite, under similar tests indicated a power of 105 percent of TNT.

The material described has been submitted to the Bureau of Mines for safety tests. An impact test was run on the Bureau's machine having a maximum height of 300 centimeters. In this machine dynamite detonates at 60 centimeters; TNT detonates at 130 centimeters. All tests of the ammonium nitrate-oil mixtures were negative, with the weight dropped from the maximum height of the machine. All friction tests were negative, even when the steel shoe was used on the pendulum, and all static electricity tests were negative. The company also ran extensive tests on spontaneous heating; all of these tests indicated that the heating hazard is no greater with ammonium nitrate-oil mixtures than for ammonium nitrate only. Therefore, the storage rules for the mixtures would be the same as for ammonium nitrate.

Hanna has developed a new system of field testing designed to give objective evaluation of the amount of work done in actual blasting. This system has not been applied as yet, but it will be in use shortly and the company is highly hopeful of its success.

How can this blasting method best be applied and marketed? Is it a "do-it-yourself" method or not? Management believes that it is a do-it-yourself method in certain applications but that a better program will be the preparation and delivery of the explosive by organizations with the training and know-how which would insure the constant control of the numerous important factors which would be subject to variations which in turn would adversely affect efficiency. In regard to the use of heavy Primacord as a primer, this material is expensive and in management's judgment less safe to use. Hanna knows of no advantages of the use of heavy Primacord in any of the systems it has developed.

The company has applied for patents on various features of the system but intends to make this blasting method readily available to the industry.

A typical blast. One of the striking features of Hanna's system is that a minimum of smoke is made in blasting and it is believed that smoke is an important indicator of the efficiency of an ammonium nitrate-oil mixture blast

SAN FRANCISCO

HOST TO AMC MINING SHOW

Record Turnout Expected For Year's Biggest Mining Event

SAN FRANCISCO, a favorite rendezvous for the mining fraternity, will welcome several thousand mining men and their ladies from all over the world September 22-26 as they gather for the American Mining Congress' 1958 Metal Mining and Industrial Minerals Convention and Exposition. Focal point of activity will be the San Francisco Civic Auditorium and the recently completed Civic Center Exhibit Hall, where both the Exposition and the general and technical Convention sessions will be held. The spectacular mining machinery exposition—the largest to date—and an outstanding array of speakers combine to make the 1958 Mining Show the year's most important mining event.

PROGRAM STRESSES NATIONAL MINERAL POLICIES

The National Program Committee, under the guidance of Chairman Frank Coolbaugh, vice president of Western Operations, Climax Molybdenum Co., has scheduled addresses on national mineral

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MRS. GEORGE STARR

policies; labor relations; taxation; public lands administration; the economic outlook for the metal mining industries; industrial minerals; gold, silver and monetary policies; strategic minerals; uranium; management problems; research and education; underground and open-pit mining; milling and metallurgy; exploration and geology; safety and health, and many other mining problems.

Officials of the Federal Government responsible for mining policies, prominent members of Congress, and leading mining men from all branches of the industry will participate in the program. They will consider mining's present status, its future, and the work that lies ahead in accomplishing industry and Government objectives.

Among those who will take part in the Convention proceedings are Senators Gordon L. Allott of Colorado, Alan Bible of Nevada, Henry C. Dworshak of Idaho, and Thomas E. Martin of Iowa; Governor Goodwin J. Knight of California; and Congressmen Hale Boggs of Louisiana, William A. Dawson of Utah, Ed Edmondson of Oklahoma, Clair Engle of California, and Walter Rogers of Texas.

Other Federal, State and City officials on the program include Thomas C. Mann, Assistant Secretary for Economic Affairs, Department of State; Elmer F. Bennett, Solicitor, U. S. Department of the Interior; Marling J. Ankeny, Director, U. S. Bureau of Mines; Edward Woozley, Director, U. S. Bureau of Land Management; Allan E. Jones, Manager, Grand Junction Operations Office, U. S. Atomic Energy Commission; Phil Holdsworth, Territorial Commissioner of Mines, Alaska; C. M. (Max) Gilliss, Director of Public Works, California Department of Public Works, and George J. Christopher, Mayor of San Francisco.

Although the general and operating sessions have been designed to cover all phases of the industry, one topic has been given special emphasis—our na-

(Continued on next page)

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tional minerals policies. In view of the serious current situation in several important branches of the mining industry, two sessions will be devoted to various facets of this vital subject. Top Executive Department officials, important members of the Senate and House, and outstanding mining men will voice their views and advance suggested policies needed to solve mining's problems.

The full program for the Convention, covering a broad range of general and technical subjects, appears on these pages. Convention-goers should study the program carefully and plan their time to obtain the maximum value from the various sessions while allowing time for a thorough study of the exhibits.

TO DRAFT POLICY DECLARATION

One of the important products of the Mining Show will be the American Mining Congress' Declaration of Policy. This will spell out the position of the mining industry on matters of national import and serve as a guide for the organization in matters of national policy.

The "Declaration" will be drawn up by the Resolutions Committee, which includes leaders in all branches of the mining industry from all sections of the country. Headed by Kenneth C. Kellar, attorney, Lead, S. D., the Committee will carefully consider all suggestions submitted to it in the work of drafting the proposed platform on which mining will take its stand during the coming year.

At appropriate times during the Convention, the reports of the Resolutions Committee will be submitted to the Convention for action. This procedure permits those attending to give fullest consideration to these important industry policies.

EXPOSITION BIGGER THAN EVER

Nearly 25 percent larger than the 1956 Exposition held in Los Angeles, this year's Mining Show will afford a better-than-ever opportunity to see and study at first hand all the machines and supplies that contribute to modern mining. More than 170 manufacturers will display their products to the mining public. Exhibits will occupy some three acres, and over 3000 exhibitors' representatives will be on hand to demonstrate equipment, answer questions and discuss special problems.

From rolls of friction tape to some of the largest off-the-highway earth movers ever made, the Exposition will feature thousands of items that make the American mining industry the most efficient and safest in the world. Underground miner, open-pit operator and mill man will all find a wide variety of products on display that have been designed to cut operating costs and boost efficiency. The Mining Show offers an unrivaled opportunity to inspect and compare all types of equipment to aid the industry in doing a better job.

(Continued on page 51)

HAROLD STRANDBERG
Alaska

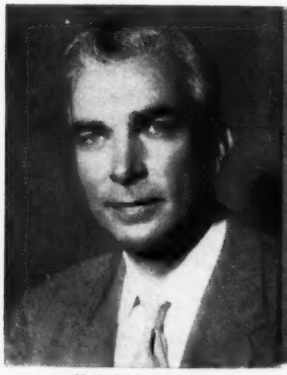
WESLEY P. GOSS
Arizona

PETER JORALEMON
California

WALTER A. WECKER
Central States

EVAN JUST
Eastern States

E. B. DOUGLAS
Idaho



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ALAN BIBLE
Senator from Nevada

HENRY C. DWORSHAK
Senator from Idaho

CONVENTION PROGRAM

(All events, except as noted, will be held at the Civic Center Exhibit Hall and Civic Auditorium)

MONDAY SEPTEMBER 22

9:00 A.M. Registration—Civic Center Exhibit Hall

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9:40 A.M. Pre-Session Motion Picture—"California and Its Natural Resources"

10:00 A.M. OPENING SESSION

Presiding: JOHN D. BRADLEY, Pres., The Bunker Hill Co., San Francisco; Chairman, Western Division, American Mining Congress

Invocation

THE VERY REVEREND C. JULIAN BARTLETT, Dean of Grace Cathedral, San Francisco

Welcome to California:

HON. GOODWIN J. KNIGHT, Governor of California

HON. GEORGE J. CHRISTOPHER, Mayor of San Francisco

Responses:

HOWARD I. YOUNG, Pres., American Zinc, Lead & Smelting Co., St. Louis; Pres., American Mining Congress

FRANK COOLBAUGH, Vice Pres., Climax Molybdenum Co., Golden, Colo.; National Chairman, Program Committee

JACK H. HOW, Pres., Western Machinery Co., San Francisco; Chairman, Manufacturers Division, A.M.C.

L. C. CAMPBELL, Pittsburgh; Chairman, Coal Division, A.M.C.

Introduction of Distinguished Guests

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Presiding: HOWARD I. YOUNG, President, American Mining Congress

Address

HON. FRED A. SEATON, Secretary of the Interior

Mining and National Security

(Speaker to be announced)

Resolutions Committee Reports:

General Policy

Solid Fuels

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1:40 P.M. Pre-Session Motion Picture—"The Petrified River"

2:00 P.M. LABOR RELATIONS

Chairman: KENNETH C. KELLAR. General Counsel, Homestake Mining Co., Lead, S. Dak.

National Labor Policies

(Speaker to be announced)

World Labor Policies—The ILO Conference on Mining

DENISON KITCHEL, Attorney, Phoenix, Ariz.

Developments in Labor Relations

RUFUS G. POOLE, Labor Attorney for the Potash Industry, Albuquerque, N. Mex.

Resolutions Committee Reports:

Labor Relations

Mine Safety

Social Security

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1:40 P.M. Pre-Session Motion Picture—"Metallurgy Plus"

2:00 P.M. MILLING AND METALLURGY

Chairman: NORMAN WEISS, Milling Engr., American Smelting & Refining Co., Salt Lake City

Autogenous Grinding

HARLOWE HARDINGE, Pres., Hardinge Co., Inc., York, Pa.

The Gyratory Ball Mill, Its Design, Principle of Operation and Performance

A. W. FAHRENWALD, Dean Emeritus, College of Mines, University of Idaho, Moscow, Idaho

Scientific Principles of the Flow of Crushed Materials

PHILIP J. ELSEY, Asst. Director, ANDREW W. JENIKE, Project Director, Bulk Solids Flow Project; and ROSCOE H. WOOLLEY, Research Engr., Utah Engineering Experiment Station, University of Utah, Salt Lake City

THOMAS E. MARTIN
Senator from Iowa

CLAIR ENGLE
Representative from California

HALE BOGGS
Representative from Louisiana

WILLIAM A. DAWSON
Representative from Utah

The Practicality of Present Day Automation

C. M. MARQUARDT, Industrial Physics and Electronics Co., Salt Lake City

New Trends in Plant Design

R. T. LASSITER, New York Dist. Mgr., and JAMES H. JENSEN, Staff Project Engr., Western-Knapp Engineering Co., San Francisco

EVENING Open—no scheduled entertainment

TUESDAY SEPTEMBER 23

9:00 A.M. Registration—Civic Center Exhibit Hall

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9:40 A.M. Pre-Session Motion Picture—"Producing America's Buried T"

10:00 A.M. NATIONAL MINERAL POLICIES

Chairman: HON. ED EDMONDSON, U. S. Representative from Oklahoma

Mineral Policies and Our Foreign Relations

HON. THOMAS C. MANN, Assistant Secretary for Economic Affairs, Dept. of State

Congressional Views on Mineral Policies

HON. GORDON ALLOTT, U. S. Senator from Colorado
HON. CLAIR ENGLE, U. S. Representative from California; Chairman, House Committee on Interior and Insular Affairs
HON. WILLIAM A. DAWSON, U. S. Representative from Utah

Resolutions Committee Report:

National Mineral Policies

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9:40 A.M. Pre-Session Motion Picture—"Sui" (pipeline construction in the Pakistan Desert)

10:00 A.M. UNDERGROUND MINING

Chairman: CHESTER H. STEELE, Vice Pres., The Anaconda Co., Butte, Mont.

Report on Survey of Underground Drilling Practices

RAYMOND STEWART, Asst. Planning Engr., Climax Molybdenum Co., Climax, Colo.

Underground Blasting with Prilled Ammonium Nitrate

JOSEPH B. ELIZONDO, Gen. Supt. of Mines, Tri-State Mines, Eagle-Picher Co., Cardin, Okla.

Hydraulic Filling in Underground Mines

RICHARD M. STEWART, Asst. to Director of Mining Research, The Anaconda Co., Butte, Mont.

Freezing Operations for Shaft Sinking in Saskatchewan

RUSSELL G. HAWORTH, Vice Pres. in Chg. of Production, Potash Co. of America, Carlsbad, N. Mex.

Roberts Tunnel Project for the City of Denver

THEODORE F. ADAMS, Project Mgr., Blue River Constructors, Arvada, Colo.

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9:40 A.M. Pre-Session Motion Picture—"A Hole Is To Dig" (open-pit operations of Foote Mineral Co.)

10:00 A.M. OPEN PIT MINING

Chairman: WALTER C. LAWSON, Vice Pres. & Gen. Mgr., Phelps Dodge Corp., Douglas, Ariz.

Incline Skip for Open Pit Hoisting

E. D. SPAULDING, Resident Mgr., Pima Mining Co., Tucson, Ariz.

Large Diameter Blast Hole Drilling and Blasting

JOHN A. LENTZ, JR., Gen. Supt., Morenci Branch, Phelps Dodge Corp., Morenci, Ariz.

Drilling and Blasting Taconite

FLOYD W. ERICKSON, Mgr., Babbitt Div., Reserve Mining Co., Babbitt, Minn.

Symposium on Ammonium Nitrate Blasting

JAMES HYSLOP, Pres., Hanna Coal Co., Div. of Consolidation Coal Co., Cadiz, Ohio
FRANK QUILICI, Pit Supt., Nevada Mines Div., Kennecott Copper Corp., Ruth, Nev.
LEWIS J. PATTERSON, Mgr., Northern Dist., Michigan Limestone Div., U. S. Steel Corp., Detroit
H. E. FARNAM, JR., Mgr. of Operations, Iron Ore Co. of Canada, Sept-Iles, Que.

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1:40 P.M. Pre-Session Motion Picture—"X Minus Eighty Days" (launching of Explorer I)

2:00 P.M. NATIONAL MINERAL POLICIES

Chairman: HON. WALTER ROGERS, U. S. Representative from Texas; Chairman, Mines and Mining Subcommittee, House Interior and Insular Affairs Committee

Canadian-Mexican Views on Mineral Policies

V. C. WANSBROUGH, Vice Pres. and Managing Director, Canadian Metal Mining Assn., Toronto, Ont.

ING. SALVADOR PENA, Mining Tax Branch, Treasury Department, Government of Mexico, Mexico City

Domestic Industry Views on Mineral Policies

CHARLES E. SCHWAB, Asst. to Pres., The Bunker Hill Co., San Francisco; Chairman, Emergency Lead-Zinc Committee

(Continued on next page)

WALTER ROGERS
Representative from Texas

ED EDMONDSON
Representative from Oklahoma

THOMAS C. MANN
Assistant Secretary of State

GEORGE J. CHRISTOPHER
Mayor of San Francisco

(Continued from previous page)

MILES P. ROMNEY, Mgr., Utah Mining Assn., Salt Lake City

LAWRENCE LITCHFIELD, JR., Vice Pres., Mining Div., Aluminum Co. of America, Pittsburgh

S. H. WILLISTON, Exec. Vice Pres., Cordero Mining Co., Palo Alto, Calif.

CLYDE L. FLYNN, JR., Arlington, Va.

CHARLES J. POTTER, Pres., Rochester & Pittsburgh Coal Co., Indiana, Pa.

HORACE M. ALBRIGHT, Consultant-Director, U. S. Borax & Chemical Corp., New York

Resolutions Committee Report:

Mine Financing

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1:40 P.M. Pre-Session Motion Picture—"The Man in the Doorway" (the modern chemical industry)

2:00 P.M. MILLING AND METALLURGY

Chairman: FRED D. DEVANEY, Chief Metallurgist, Pickands Mather & Co., Duluth, Minn.

Production of Metallic Iron Concentrates Involving Direct Reduction

ALEX STEWART, Pres., retired, The R-N Corp., New York

Dry Magnetic Concentration Methods

P. E. CAVANAGH, Director of Metallurgy, Ontario Research Foundation, Toronto, Ont.

Iron Ore Beneficiation and High Tension Separation

ROGER E. BARTHELEMY, Director of Research, and J. HALL CARPENTER, Pres., Carpco Engineering and Research, Inc., Jacksonville, Fla.

Remarks on Some Advances in Uranium Ore Processing

WILLIAM L. LENNEMAN, Metallurgical Engr., Raw Materials Div., U. S. Atomic Energy Commission, and FRANK E. MCGINLEY, Chief, Procurement Services Branch, AEC Grand Junction Operations Office

Improvements in Filtration

ROBERT B. THOMPSON, Filter Div., The Eimco Corp., Salt Lake City

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1:40 P.M. Pre-Session Motion Picture—"Make Mine Safety"

2:00 P.M. SAFETY AND HEALTH

Chairman: HON. MARLING J. ANKENY, Director, U. S. Bureau of Mines.

The Science of Mine Ventilation

JOHN W. WARREN, Chief Ventilation & Industrial Hygiene Engr., The Anaconda Co., Butte, Mont.

Future Aspects of Underground Ventilation

RAYMOND MANCHA, Vice Pres. retired, Joy Manufacturing Co., Pittsburgh

Safety in the Mining Organization

CHARLES R. KUZELL, Director, Phelps Dodge Corp., Phoenix, Ariz.

Evaluation of Radiation Hazards in Uranium Mining

DUNCAN A. HOLADAY, Director, Occupational Field Station, U. S. Public Health Service, Salt Lake City

Costs of Mine Accidents

HERBERT R. WESTLUND, Chief Safety Engr., Argonaut Insurance Co., Menlo Park, Calif.

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6:30 P.M. MINERS JAMBOREE — "CHUCK WAGON" DINNER

Palace of Fine Arts

SEPTEMBER 24

9:00 A.M. Registration—Civic Center Exhibit Hall

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9:40 A.M. Pre-Session Motion Picture—"Golden Horizons" (early development of California)

10:00 A.M. TAX PANEL

Chairman: HON. THOS. E. MARTIN, U. S. Senator from Iowa

HON. HALE BOGGS, U. S. Representative from Louisiana

ELLSWORTH C. ALVORD, Alvord & Alvord, Washington, D. C.; Tax Counsel, A.M.C.

Other speakers to be announced.

Resolutions Committee Reports:

Taxation

Government Expenditures

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GOLD, SILVER AND MONETARY POLICIES

Co-Chairmen:

DONALD H. MCLAUGHLIN, Pres., Homestake Mining Co., San Francisco; Chairman, Gold Producers Committee, A.M.C.

JOSEPH T. HALL, Pres., Callahan Mining Corp., New York

Gold

(Speaker to be announced)

U. S. Silver Policy

HON. ALAN BIBLE, U. S. Senator from Nevada

Observations on Silver

D. L. FEATHERS, Vice Pres. & Secy., The Bunker Hill Co., San Francisco

ELMER F. BENNETT
Solicitor, Department of the Interior

EDWARD WOOZLEY
Administrator Bureau of Land Management

MARLING J. ANKENY
Director U. S. Bureau of Mines

PHIL R. HOLDSWORTH
Territorial Commissioner of Mines Juneau, Alaska

Resolutions Committee Report:

Gold, Silver and Monetary Policies

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9:40 A.M. Pre-Session Motion Picture—"The Eighth Sea" (story of the St. Lawrence Seaway)

10:00 A.M. UNDERGROUND MINING

Chairman: ELMER A. JONES, Div. Mgr., St. Joseph Lead Co., Bonne Terre, Mo.

Longwall Stoping With Yieldable Steel Props at the Radon Mine

WILLIAM H. LOVE, Mgr. of Mines, Hecla Mining Co., Wallace, Idaho, and PHILIP M. LINDSTROM, Supt. of Utah Operations, Moab, Utah

Mechanical Mining in Eastern Tennessee

HARRY L. MILLER, Supt., Jefferson County Operations, American Zinc Co. of Tenn., Mascot, Tenn.

Mining by Hydraulic Jet

JOHN H. BAKER, Supt., American Gilsonite Co., Salt Lake City

Why the Circular Shaft?

WILLIAM F. SHINNERS, Mgr., Michigan Mines, M. A. Hanna Co., Iron River, Mich.

Use of Metal Liners in Ore Passes

ROBERT W. BRAUND, Mgr. of Michigan Mines, and R. L. BALCONI, Supt., Tracy Mine, Jones & Laughlin Steel Corp., Negaunee, Mich.

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12:15 P.M. STRATEGIC MINERALS LUNCHEON—Hotel Whitcomb

Presiding: S. H. WILLISTON, Exec. Vice Pres., Cordero Mining Co., Palo Alto, Calif.; Chairman, Strategic Minerals Committee, A.M.C.

Guest Speaker: HON. HENRY C. DWORSHAK, U. S. Senator from Idaho

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1:40 P.M. Pre-Session Motion Picture—"The Claim Stakers" (claim location and recording in Canada)

2:00 P.M. PUBLIC LANDS

Chairman: To be announced

Impact of Recent Court Decisions on the "Rule of Discovery"—A Panel Discussion

RAYMOND B. HOLBROOK, Counsel, U. S. Smelting Refining & Mining Co., Salt Lake City

ROBERT S. PALMER, Exec. Vice Pres., Colorado Mining Assn., Denver

R. LAUREN MORAN, Attorney, Riverton, Wyo.

OSCAR W. WORTHWINE, Attorney, Boise, Idaho

HON. ELMER F. BENNETT, Solicitor, U. S. Department of the Interior

Developments Under Public Law 167—The "Multiple Use" Act of 1955

HON. EDWARD WOOZLEY, Director, Bureau of Land Management

Proposed Changes in Assessment Work Requirements

W. HOWARD GRAY, Attorney, Ely, Nev.; Chairman, Public Lands Committee, A.M.C.

Land Withdrawal Policies

HON. PHIL R. HOLDSWORTH, Territorial Commissioner of Mines, Juneau, Alaska

Resolutions Committee Reports:

Public Land Policy

Water and Air Pollution

◆ ◆ ◆

1:40 P.M. Pre-Session Motion Picture—"It's Only The Beginning" (scientific research in the United States)

2:00 P.M. RESEARCH AND EDUCATION

Chairman: LEE A. DUBRIDGE, Pres., California Institute of Technology, Pasadena, Calif.

Nuclear Explosions—Possible Mining Applications

GERALD W. JOHNSON and DAVID D. RABB, University of California Radiation Laboratory, Livermore, Calif.

The Role of Research in Marketing Nonferrous Metals

W. M. PEIRCE, Asst. to Exec. Vice Pres., New Jersey Zinc Co., New York

Research on New Uses for Mineral Products

R. H. THIELEMANN, Chr., Dept. of Metallurgy, Stanford Research Institute, Menlo Park, Calif.

Supply, Demand and Futue Outlook for Mining Engineers

JOHN W. VANDERWILT, Pres., Colorado School of Mines, Golden, Colo.

◆ ◆ ◆

1:40 P.M. Pre-Session Motion Picture—"Penny A Pound" (the making of cement)

2:00 P.M. OPEN PIT MINING

Chairman: RICHARD W. WHITNEY, Vice Pres., Hanna Coal and Ore Corp., Cleveland

Over-All Berkeley Pit Operation

E. I. RENOUARD, Mgr. of Mines, The Anaconda Co., Butte, Mont.

Progress at Asarco's Black Lake Asbestos Project

VICTOR I. MANN, Vice Pres., Lake Asbestos of Quebec, Ltd., New York

Truck Haulage Improvements

J. C. VAN DE WATER, Gen. Supt. of Mines, Ray Mines Div., Kennecott Copper Corp., Ray, Ariz.

L. J. MORGAN, Mobile Equipment Supervisor, M. A. Hanna Co., Hibbing, Minn.

(Continued on next page)

(Continued from previous page)

Planning and Scheduling Maintenance

JAMES A. VITZTHUM, Supt. of Maintenance, Oliver Iron Mining Div., U. S. Steel Corp., Virginia, Minn.

EVENING Open—no scheduled entertainment

THURSDAY SEPTEMBER 25

9:00 A.M. Registration—Civic Center Exhibit Hall

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9:40 A.M. Pre-Session Motion Picture—"The Big Picture —Pentomic Army"

10:00 A.M. STATE OF THE METAL MINING INDUSTRIES

Chairman: FRANK COOLBAUGH, Vice Pres., Climax Molybdenum Co., Golden, Colo.

Nonferrous Metals

SIMON D. STRAUSS, Vice Pres., American Smelting & Refining Co., New York

Iron Ore

HERBERT C. JACKSON, Managing Partner, Pickands Mather & Co., Cleveland

Light Metals

WALTER L. RICE, Pres., Reynolds Mining Co., Richmond, Va.

Strategic Metals

F. A. MCGONIGLE, Vice Pres., Howe Sound Co., New York

Rare Metals

MITCHELL H. KLINE, Vice Pres., Rare Metals Corp. of America, Salt Lake City

Uranium

ALLAN E. JONES, Mgr., Grand Junction Operations Office, U. S. Atomic Energy Commission, Grand Junction, Colo.

Boron

J. FREDERICK CORKILL, Vice Pres. & Gen Mgr., Pacific Coast Borax Company Division, U. S. Borax & Chemical Corp., New York

Resolutions Committee Report:

Uranium

◆ ◆ ◆

9:40 A.M. Pre-Session Motion Picture—"Asbestos A Matter of Time" (mining of asbestos)

10:00 A.M. INDUSTRIAL MINERALS

Chairman: C. E. WUERPEL, Vice Pres., Marquette Cement Manufacturing Co., Chicago

Impact of the Federal Road Program on the Mineral Industries

LOUIS W. PRENTISS, Maj. Gen., U.S.A. (ret.), Exec. Vice Pres., and CHARLES E. CURTISS, Special Asst. to Exec. Vice Pres., American Road Builders Assn., Washington, D. C.

Raw Material Requirements for the Federal Road Program

C. M. (MAX) GILLISS, Director of Public Works, California Dept. of Public Works, Sacramento, Calif.

High Temperature Gas Cleaning in Cement Plants Using Fabric Filters

GORDON BARR, Production Engr., Southwestern Portland Cement Co., Los Angeles

Use of Industrial Minerals in Basic Refractories

JAMES C. HICKS, Research Director, Chemical Div., Kaiser Aluminum & Chemical Corp., Oakland, Calif.

◆ ◆ ◆

9:40 A.M. Pre-Session Motion Picture—"Barrel Number One" (exploration for oil)

10:00 A.M. EXPLORATION AND GEOLOGY

Chairman: PETER JORALEMON, Consulting Geol., San Francisco

Exploration of Large Areas

STANLEY E. JEROME, Dist. Geol. Coordinating Unit, Bear Creek Mining Co., Salt Lake City

Exploration at INCO

RALPH D. PARKER, Vice Pres., International Nickel Co. of Canada, Ltd., Toronto, Ont.

Geophysical Exploration Methods

LOUIS B. SLICHTER, Director, Institute of Geophysics, University of California, Los Angeles

Exploration Drilling Techniques

V. N. BURNHART, Vice Pres., E. J. Longyear Co., Minneapolis

◆ ◆ ◆

12:15 P.M. LUNCHEON, BOARD OF GOVERNORS, WESTERN DIVISION, A.M.C.

Nob Hill Room, Fairmont Hotel

◆ ◆ ◆

1:40 P.M. Pre-Session Motion Picture—"This Is Automation"

2:00 P.M. MANAGEMENT PROBLEMS

Chairman: C. D. MICHAELSON, Gen. Mgr., Western Mining Divs., Kennecott Copper Corp., Salt Lake City

The Role of Engineering in Management

TOM WARE, Pres., International Minerals & Chemical Corp., Chicago

Long Range Open Pit Planning

ADOLPH SODERBERG, Consulting Engr., Mining, Western Mining Divs., Kennecott Copper Corp., Salt Lake City

Training Young Engineers

R. O. HAWKANSON, Vice Pres., Oliver Iron Mining Div., U. S. Steel Corp., Duluth, Minn.

Supervisory Development Program

JOHN M. PETTY, Asst. Gen. Supt., Climax Molybdenum Co., Climax, Colo.

1:40 P.M. Pre-Session Motion Picture—"The Big Z" (uranium in Canada)

2:00 P.M. URANIUM

Chairman: D. W. VILES, Vice Pres., Vanadium Corp. of America, Durango, Colo.

Nuclear Energy and the Future

R. D. BENNETT, Mgr., Vallecitos Atomic Laboratory, General Electric Co., Pleasanton, Calif.

Texas-Zinc Minerals Project at Mexican Hat

NEILL K. BANKS, Gen. Mgr., Texas-Zinc Minerals Corp., Grand Junction, Colo.

Open-Pit Uranium Mining in Wyoming

ALBERT V. QUINE, Gen. Mgr., Lucky Mc Uranium Corp., Riverton, Wyo.

Symposium on Ambrosia Lake Mining—the Problems

RAY JENKINS, Supt. of Mines, Phillips Petroleum Co., Grants, N. Mex.
Other speakers to be announced

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7:00 P.M. A.M.C. DINNER DANCE—Sheraton-Palace Hotel

FRIDAY SEPTEMBER 26

9:30 A.M. to 4:30 P.M.

TAX FORUM—open to all interested mining men, Golden Empire Room, Mark Hopkins Hotel

Chairman: LINCOLN ARNOLD, Chairman, Tax Committee, American Mining Congress

Discussion of current tax problems of the mining industry—including such items as determination of the "property" upon which depletion is based; provisions of the "Mills Bill" of interest to mining; methods of allocation of indirect expenses; and other matters of general interest to mining taxpayers—with ample opportunity for questions and discussion from the floor.

(Continued from page 44)

Brief descriptions of the exhibits are presented in a special section in subsequent pages. These convey a hint of what is in store for the visitor and deserve close study. Most of the exhibits will feature demonstrations of full-size machinery and equipment, while other exhibitors will use models, cutaways or action displays to illustrate operating characteristics and performance.

Manufacturers' representatives will be on hand to be of all possible help. Many of them are engineers or technicians and all of them appreciate the problems faced in the day-to-day operation of mining properties. They will be happy to take as much time as necessary to discuss the applications of the new equipment on display or to make suggestions for the most efficient use of existing equipment under particular conditions. Be sure to take advantage of this opportunity to investigate the different ways of performing the work that is your responsibility.

The AMC Mining Show offers an outstanding educational opportunity. Nowhere else is it possible to meet so many industry leaders, learn so much about latest operating procedures, and see the largest display of mineral producing equipment in the world at the same time. Executives who have sent key technical and production men to these meetings have found that the broader knowledge and renewed enthusiasm brought back from the Mining Show more than pays off in new ideas and greater efficiency throughout the year.

ENTERTAINMENT

San Francisco, one of the most cosmopolitan and hospitable cities in the world, offers a wide variety of fine eating places and entertainment as well as beautiful and historic scenic attractions to its visitors. Mining Congress Conventions, too are famous for fun and good fellowship. Put the two together and you are in for a memorable week.

A special entertainment program has been arranged for Tuesday and Thursday evenings. Monday and Wednesday evenings have been left open for convention-goers to get together with old or new friends and enjoy the many attractions of San Francisco.

On Tuesday evening, September 23, a "Miners Jamboree" will feature a real western-style dinner at the historic Palace of Fine Arts, famed reminder of the 1915 World's Fair. A record crowd is expected to turn out for a "chuck-wagon" dinner and an evening of dancing and entertainment. Bands will provide continuous music, and the top-notch entertainment program is certain to please.

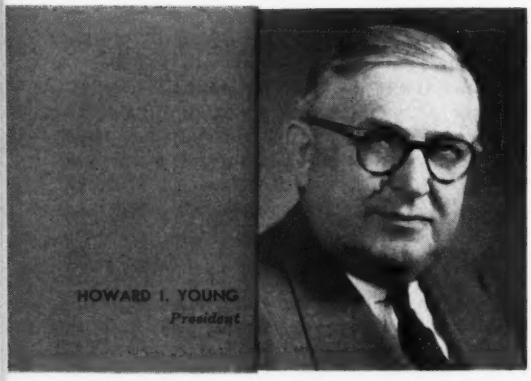
The social climax to the Convention will be the AMC Dinner Dance on Thursday evening. It will be held in the world-famous atmosphere of the Garden Court and adjoining ballrooms at the Sheraton-Palace Hotel. Nothing is being overlooked to make this affair one to be long remembered. Informality will be the keynote of the evening.

The Mining Show takes place when the San Francisco opera season is at its height. Guiseppe Verdi's great operas "Don Carlo" and "Il Trovatore" will be presented on Saturday, September 20, and Friday, September 26, respectively. On Saturday evening, September 27, in honor of the one-hundredth anniversary of Puccini's birth, an entirely new production of "La Boheme" will be given.

As an accommodation to Mining Show visitors, a special block of seats was set aside by the Opera Association for each of these performances. This was widely publicized to the industry, and a large number of those attending the Convention have

(Continued on page 53)

DIRECTORS AMERICAN MINING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CONGRESS

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MERL C. KELCE

GEORGE H. LOVE

RAYMOND E. SALVATI

MERRILL E. SHOUP

S. H. WILLISTON

J. E. M. WILSON

(Continued from page 51)

taken advantage of this opportunity to hear opera at its best.

FOR THE LADIES

As always, the ladies have been extended a special invitation to come to San Francisco. In addition to the Convention sessions, Exposition, trips and evening functions, they are particularly invited to take part in the fine program of day-time events arranged for their enjoyment.

Monday afternoon the Alta Mira Hotel in Sausalito, overlooking San Francisco Bay, will be the scene of a reception and tea. Enroute from downtown, the buses will pass many of the City's interesting landmarks—including Chinatown, Coit Tower, Fisherman's Wharf, the Marina, the Presidio, and the spectacular Golden Gate bridge.

Tuesday, the Castlewood Country Club at Pleasanton in the rolling hills of California's wine country will be the setting for a charming ladies luncheon. The trip from San Francisco will pass through the picturesque East Bay area, immortalized in literature by Bret Harte, Jack London and Joaquin Miller.

San Francisco, famed for its fashionable women, chic shops and cosmopolitan atmosphere, is the ideal setting for a style show. On Wednesday, following luncheon at the Fairmont Hotel, Saks Fifth Avenue will present a special showing of sophisticated fashions for fall and winter.

Ladies headquarters will be in the Garden Room at the Fairmont Hotel beginning Sunday, September 21, and coffee will be served each morning.

SPECIAL EVENTS

Repeated by popular demand, the great AMC Salmon Derby is scheduled for Friday, September 26. Special preparations have been made to outfit the AMC fishing fleet. Each of the clean, comfortable power cabin boats is capable of carrying eight to ten anglers comfortably. Tackle and bait will be provided and a box lunch served. Special prizes will be given for the best catch.

In its quest for the "big ones", the fleet will sail through the Golden Gate and up the beautiful Marin Coast, past Muir Woods, Stinson Beach, and Pedro Point.

Two interesting trips down the peninsula from San Francisco have also been arranged for Friday. Trip "A" will feature a visit to one of the world's largest cement plants, Kaiser's Permanente plant located in the Santa Clara hills. After lunch at the Los Altos Golf and Country Club, the trip will continue to the Ford Motor Company's new San Jose Assembly plant at Milpitas.

Those taking Trip "B" will tour Stanford Research Institute at Menlo Park, with particular attention paid to the work of the metallurgical group and the Earth Sciences Division. Following a drive through Stanford University Campus, Trip B will join Trip A for luncheon. In the afternoon a visit will be made to the Palo Alto plant and laboratory of Hewlett-Packard Company, manufacturer of electronic and scientific equipment. A visit to the publishing facilities of Sunset Magazine will round out the day.

(Continued on page 63)

AMC STAFF

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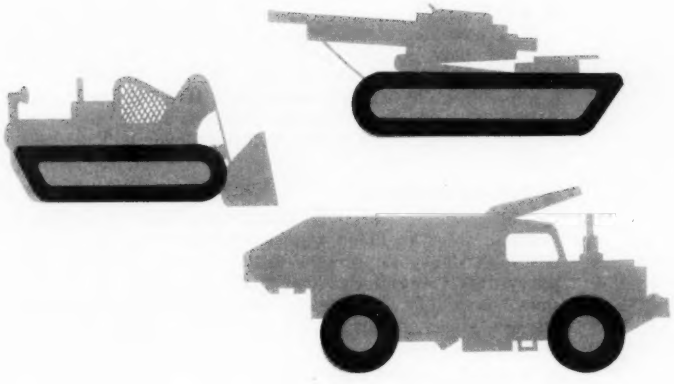

JACK H. HOW
Chairman
Manufacturers Division

THE EXPOSITION

More than 175 manufacturers and suppliers of mining equipment will use 110,000 net square feet to display their products and services in San Francisco's Civic Center Exhibit Hall and Civic Auditorium. Read the following exhibit descriptions closely and make note of those you particularly want to see. This preview is your key to maximum dividends from the "greatest mining show on earth"

EXHIBITORS

■ ***ACME HAMILTON MANUFACTURING CORP.***
ACME PACIFIC DIVISION

Will show its complete line of mechanical rubber goods.

■ ***AEROQUIP CORP.***
WESTERN DIVISION

Will have low, medium and high pressure hoses and self-sealing couplings for virtually all types of fluid-carrying applications. Featured will be the new Aeroquip truck air brake hose with segmented fittings.

■ ***AERO SERVICE CORP.***

Test record tapes over known ore bodies, made with the Aero/Newmont Electromagnetic Detector, will be featured. Other services to be shown include airborne magnetometer surveys, photo-geologic studies, photo interpretation for engineering uses, and relief models. In addition, topographic mapping for mining development purposes or stockpile inventory will be shown.

■ ***ALLEN-SHERMAN-HOFF PUMP CO.***

Exhibit will feature the Frame D-6-5 rubber-lined slurry pump of split shell construction. It is one of the world's largest pumps with replaceable rubber lining.

■ ***ALLIS-CHALMERS MANUFACTURING CO.***

Plans to show a cutaway model of an air spring of the type now available on its floor-mounted vibrating screens, a model of the ACL system for burning cement clinker, a rubber-lined pump, a panel display of Allis-Chalmers compacting process, and a backdrop showing cross section of the Hydroset crushing mechanism. In addition,

(Continued on next page)

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a line of construction machinery will be exhibited, including crawler tractors, tractor shovels, motor grader, motor scraper and wagon, gasoline and diesel power units, generator set, and a fan to flywheel engine.

■ ***ALLOY STEEL AND METALS CO.***

Pacific mining equipment to be exhibited includes Slushmaster scrapers, sheave blocks and manganese steel mine car wheels.

■ ***AMERICAN AIR FILTER CO., INC.***

Will show a complete line of dust control products, all in operation. Included in the exhibit will be both wet and dry type collectors.

■ ***AMERICAN BRATTICE CLOTH CORP.***

Display will illustrate American Brattice Cloth's two main products—brattice cloth and ventilation tubing. Samples will be shown of different fabrics and grades of material which are available. There will also be a sample of ABC's new spiral wire reinforced tubing which can be used for exhaust ventilation, as well as for blowing.

■ ***AMERICAN CYANAMID CO.***
EXPLOSIVES & MINING CHEMICALS DEPARTMENT

Plans to feature some of its permissibles and high explosives for open-pit and underground mining. In addition, blasting caps, blasting aids and accessories will be shown. Cyanamid's mining chemicals for metallic and non-metallic flotation will be exhibited and a new product, which is used for preventing wind and rain erosion of mineral and coal fines, will be introduced.

■ ***AMERICAN MANGANESE STEEL DIVISION***
AMERICAN BRAKE SHOE CO.

A large working model of Amsco's two-part dipper tooth will be featured. Eight other digging teeth, some dating back 40 years, will also be shown. The benefits of a double wave ball mill liner will be demonstrated by a miniature mill in operation. Samples of impact resistant manganese steel castings will complete the exhibit.

■ ***AMERICAN MINE DOOR CO., THE***

Will feature its air-powered car transfer and air-powered switch thrower. Both items will be operating under simulated mining conditions. Also on display will be a one-eighth size scale model of a new self-propelled all hydraulic track cleaner.

■ ***AMERICAN SMELTING AND REFINING CO.***

Plans to display three electronically activated maps which indicate the processing of non-ferrous ores and the extraction of 16 elements usable in industry.

■ ***ATLAS COPCO PACIFIC, INC.***

Exhibit will feature a complete selection of rock drills, detachable tungsten-carbide bits, the Cobra self-contained gas-powered rock drill, air lamps, air hoists, lightweight galvanized pipe, air compressors and a display of Sandvik Coromant drill steels.

■ ***ATLAS POWDER CO.***

Will feature a motion picture of the record-breaking Morrison-Knudsen Co. blasts at Little Valley, Utah, and demonstration of the Atlas Blasting Cost Chart, a method to help users of explosives keep track of their costs. New products, including the Arcmaster time-limiting blasting switch, will also be exhibited.

■ ***AUSTIN-WESTERN, CONSTRUCTION EQUIPMENT DIV., BALDWIN-LIMA-HAMILTON CORP.***

See Baldwin-Lima-Hamilton Corp.

■ ***BALDWIN-LIMA-HAMILTON CORP.***
CONSTRUCTION EQUIPMENT DIVISION

Display will feature lighted transparencies picturing B-L-H products for the mining industry. Among the transparencies will be illustrations of shovels and draglines manufactured at the Lima Works Division, coal mining dump cars built by the Eddystone Division, and hydraulic cranes and graders manufactured by the Austin-Western Division.

■ ***BAND-IT CO.***

Will have on display three new products: Brack-Its, Swaged hose nipples and two-in. hose nipple pusher adapter. Other company products to be exhibited include clamps, hose nipples, hose menders, swivel adapter unions, Scru-Lokt buckles, hose nipple pushers, bench mount, air clamping tools, air-operated clamp remover and accessory items.

■ ***BARBER-GREENE CO.***

Will exhibit material handling equipment applicable to metal mining. Included will be permanent belt conveyors, portable conveyors, screens and loaders. A 48 by 6 in. heavy duty troughing carrier and return roll, cut away to show heavy duty components, will be featured. For screening wet, sticky materials, Barber-Greene Duo-Screens will be demonstrated.

■ ***BARRETT, HAENTJENS & CO.***

Description not available.

■ ***BEMIS BRO. BAG CO.***

Plans to exhibit Flexipipe, a collapsible ventilation tubing used to direct fresh air to wherever it is needed in underground mines and tunnels. Various types of bags used by mining companies will also be shown.

■ ***BENDIX AVIATION CORP.***

Will feature the Bendix Nuclear Density Gauge which indicates and controls the density or specific gravity of liquids and slurries.

■ ***BETHLEHEM PACIFIC COAST STEEL CORP.***

Featured will be a replica of a mine interior showing how mine roof bolts and yieldable arches perform. The new K-type shell roof bolts will be on display, as will be various examples of mining ropes and drill steel.

■ ***BIXBY-ZIMMER ENGINEERING CO.***

All types of Bixby-Zimmer welded stainless steel screens will be displayed.

■ ***BOSTON WOVEN HOSE & RUBBER CO.***
DIVISION OF AMERICAN BILTRITE RUBBER CO., INC.

Will feature its method of balanced belt construction. Also featured will be Boston's V-belts which combine dacron tensile members and Neoprene with fibre-dispersed stock in the compression member.

■ ***BOYLES BROS. DRILLING CO., LTD.***

Will show a wide range of drills and equipment. Featured will be a deep hole diamond rotary drill with fluid drive, hydraulic reversing unit, and centralized power operated controls for both drill and auxiliary equipment. Also shown will be a lightweight, air-powered diamond drill with eye bolt anchor and bipod mounting.

■ ***BRODERICK & BASCOM ROPE CO.***

Description not available.

■ ***BROWN, INC., DAVID***

Visitors will be able to watch a Radicon worm reducer at work. Other equipment featured in the display will be speed reducers, gear motors, cone ring couplings, and the new helical worm box.

■ ***BRUNNER & LAY ROCK BIT CORP.***

Plans to exhibit a complete line of carbide inserted Rok-Bits. Also being exhibited will be Brunner & Lay alloy and carbon drill steels in both round and hexagon bodies, along with sectional drill rods and couplings.

■ ***BUCYRUS-ERIE CO.***

A working model of Bucyrus-Erie's 6-cu yd 150-B electric shovel will be featured. Scaled to 1/12 size, it actually

performs all shovel functions—hoist, swing, crowd, retract and propel.

■ **BUELL ENGINEERING CO.**

Exhibit will feature centrifugal, gravitational, and inertia-gravitational classifiers. Working models with observation ports will be on display.

■ **BUSH ENGINEERING & MANUFACTURING CO.**

A demonstrating unit of the T & R classifier-concentrator gravity separator will be shown. This equipment is applicable to many different ores—concentrating, classifying, upgrading and desliming.

■ **C & D BATTERIES, INC.**

Highlighting this exhibit will be two new high-capacity Slyver-Clad mining batteries and motive power batteries plus PlastiCell and PlastiCal stationary batteries designed for control, switchgear and auxiliary power applications.

■ **CARD IRON WORKS CO., C. S.**

Will show working models of some of its products.

■ **CARPCO MANUFACTURING, INC.**

Will exhibit a pilot plant featuring a high tension separator for iron ore beneficiation. In addition there will be a display showing high tension separation of salt water from oil.

■ **CATERPILLAR TRACTOR CO.**

Center of the display will be a D-9 tractor with ripper and bulldozer. A D-8 tractor with bulldozer and hydraulic tilt cylinder will also be shown. Another attraction will be a scrubber-equipped No. 933 Traxcavator with side dumping bucket. The side dumping bucket will be animated to demonstrate its operation. Other equipment to be displayed includes a DW20 wheel tractor and new Athey PW20 bottom dump wagon; a D311 diesel engine, a D353 diesel-electric set, and a bulldozer which combines ripping and dozing into one operation.

■ **CHICAGO PNEUMATIC TOOL CO.**

Featured will be the G-800 crawler-mounted Tracdril with a 4½-in. deep-hole drill and a CP-600 rotary compressor. It is planned to have this unit supported on jacks to show the operation and deadman control of the tracks. In addition, the exhibit will introduce the new CP-65 air-operated diamond drill and show skid-mounted diamond drills, sinker drills, demolition tools, pumps, hoists, stopers, impact wrenches and sinker air-legs.

■ **CHRISTENSEN DIAMOND PRODUCTS CO.**

Will have on display a selection of coring and non-coring bits showing various bit designs and adaptations. A special feature will be a new long nose pilot bit that cores ahead of the circulating fluid. Visitors will also see an unusual collection of cores cut in the United States and cutaway core barrels showing the different features of double tube rigid, Series D mining barrels and 250-P oil field core barrel.

■ **CLARK EQUIPMENT CO.**
CONSTRUCTION MACHINERY DIVISION

Will exhibit a new addition to the Michigan Line, the 13-ton capacity Model 110 rear dump. In addition, the 6-cu yd Model 375A tractor shovel and the 375-hp Model 380 tractor dozer will be displayed.

■ **COAST MANUFACTURING & SUPPLY CO.**

Booth will feature displays of safety fuse and Primacord Bickford, plus their accessories.

■ **COLORADO FUEL & IRON CORP., THE**

A complete line of CF&I's mining products will be on display including: Wickwire rope, industrial screens, grinding balls and rods, rock bolts and mine rails and accessories. In addition, the exhibit will feature a Hospitality Center—a complete secretarial service will be staffed to write letters, send telegrams, take messages and help in any way possible. Comfortable seating will be available as well as telephone service.

■ **CONNELLSVILLE MANUFACTURING & MINE SUPPLY CO.**

See Contract Engineering Co.

■ **CONTRACT ENGINEERING CO.**

Will join with Connellsville Manufacturing & Mine Supply Co. and Derrick Manufacturing Co. in displaying an operating production sized Derrick integral motor, high frequency vibrating screen. Exhibit will also have a complete photograph and literature display describing Contract Engineering's Koepe-type friction hoists and complete mine shaft equipment as manufactured by Connellsville.

■ **CRUCIBLE STEEL CO. OF AMERICA**

Will exhibit samples of its full range of products for the mining industry. Individual panels will show drill steel, tool and high speed steel, stainless steel and wire, cold rolled steel, permanent magnets and heavy industrial springs.

■ **CUMMINS ENGINE CO., INC.**

Five Cummins' engines will be displayed—600-hp VT-12, 375-hp NFT-6, 320hp NHRIS6-TC, 375-hp V-8 and a 75-hp J-4 generator set (30 kw).

■ **CURTISS-WRIGHT CORP.**
SOUTH BEND DIVISION
UTICA DIVISION

The South Bend Division will feature a 35-ton rear dump unit. The Utica Division will have on display five Mercedes-Benz diesel engines. These consist of a heavy duty pumping unit, a 95-kw generator set, an industrial unit with power take-off (this engine being the 36-hp, 400-lb engine used to power the German 180-D automobile), a 96 hp @ 2600 rpm unit that weighs 780 lb, and a 564 hp @ 2200 rpm engine that weighs 3000 lb.

■ **DENVER EQUIPMENT CO.**

Featured will be a 1000 gpm adjustable stroke diaphragm pump. The Model E Denver Pump, which is available in sizes from one-in. simplex to ten-in. duplex was introduced by Denver Equipment last year.

■ **DERRICK MANUFACTURING CO.**

See Contract Engineering Co.

■ **DETROIT DIESEL ENGINE DIVISION**
GENERAL MOTORS CORP.

Exhibit is made up of a 210-hp truck engine and models for other mining equipment requiring a comparatively small, lightweight engine of high power output. The 210-hp model is a 6-cylinder Series 71 unit. Other models to be displayed include a 300-hp Series 110 engine, a Hydrostarter model and 4- and 6-cylinder Series 71 engines for excavators, cranes and other mining equipment. Activated cutaway units showing the two-cycle operation of GM diesel engines will also be shown.

■ **DIAMOND IRON WORKS DIVISION**
GOODMAN MANUFACTURING CO.

Will feature conveyors, crushers and screens.

■ **DIAMOND TOOL RESEARCH CO., INC.**

Exhibit will consist of a complete sample line showing coring, non-coring, casing and reaming shell bits in many sizes. A display of five grades of loose diamonds used in DTR bits and actual samples from the line of DTR diamond products used in other industries will complete the exhibit.

■ **DOW CHEMICAL CO., THE**

The Dow Chemical Co., producers of a wide variety of flotation and flocculating agents essential to mining, will sponsor a hospitality booth.

■ **DU PONT DE NEMOURS & CO., INC., E. I.**

Exhibit will feature a pictorial presentation on the history-making Ripple Rock blast, and will include the pres-

(Continued on next page)

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entation of a new documentary motion picture on the planning, development and execution of the blast. Products used in the project will also be shown.

■ **EIMCO CORP., THE**

Will exhibit its line of underground and surface mining excavating equipment, front end loaders, bulldozers, tractors, etc. In addition, there will be at least one new piece of equipment never shown before which might be described as a continuous rock loading machine with a capacity of about four tpm. Eimco will also exhibit filtration and processing equipment.

■ **ELECTRIC STEEL FOUNDRY CO.**

Is making every effort to provide a comfortable booth, equipped with easy chairs and water cooler, and cordially invites all Mining Show visitors to meet ESCO's representatives in a relaxing atmosphere.

■ **ELECTRIC STORAGE BATTERY CO., THE**
EXIDE INDUSTRIAL DIVISION

The new Exide-Ironclad batteries with armored porous tubular positive plates will be featured. Cutaway cells will show the design and assembly of this multi-tubular battery. Also featured in the exhibit will be a typical mine charger.

■ **ENGINEERING AND MINING JOURNAL**

Display will illustrate the varied services E&MJ offers the world-wide metal and nonmetallic mining industries.

■ **EQUIPMENT ENGINEERS INC.**

A full line of single and patented two-stage Krebs cyclones equipped with hydraulic or air-operated apex controls and super-ceramic fixed apex orifices will be displayed. A central feature of the exhibit will be an operating Krebs cyclone. The Model C Clarkson Slurry Valve will be introduced, and Clarkson Feeders Model E in 18-8 stainless steel and in PVC (for acids) will also be shown.

■ **EUCLID DIVISION**
GENERAL MOTORS CORP.

On display for the first time at the Mining Show will be Euclid's new R-27, a 27-ton rear dump which was introduced in March of this year. Also on display will be the new series TC-12 crawler tractor and the TS-24 Twin Power scraper.

■ **FAIRCHILD AERIAL SURVEYS, INC.**

Fairchild's experience in aerial survey work all over the world will be highlighted in an exhibit showing the 40-odd countries where aerial surveys have been flown in the past 35 years. Featured concurrently in this exhibit will be a display of results obtained with Fairchild's newest exploration tool, the helicopter-borne electromagnetic system.

■ **FIRTH STERLING INC.**

Will display its complete line. Firthite Blue Bit mining tools will be shown, including machine bits, roof bits, drill bits, finger bits and drill bit inserts. Featured will be percussion (rock bit) inserts, as well as carbide cutting tools, tips, inserts and high speed steel production tools.

■ **FLEXIBLE STEEL LACING CO.**

A 20-ft conveyor in operation at the exhibit will utilize a 24-in. belt, spliced at intervals with various types of belt fasteners—i.e., Flexco, Flexco hinged belt fasteners and, Alligator belt lacing. In addition, Rema self-vulcanizing rubber repair material will be shown on the belt. Flexible Steel Lacing will also exhibit the FarPul belt clamps and new improved tools for the application of its belt fasteners.

■ **GALIGHER CO., THE**

To be displayed are the Agitair flotation machine, Vacseal pump, Galigher acid-proof sump pump and the Geary-Jennings sampler. Operating models of each product will be included, and samples of construction materials and parts of all sizes of the replaceable liner Vacseal pumps will be displayed. A new all plastic sump pump in operation will also be exhibited.

■ **GARDNER-DENVER CO.**

Products to be featured consist of stopers, sinker drills, drifters, Air Trac drills, portable air compressors, steel display, bit and steel grinders, sump pumps, mine carloaders, grout pumps, slushers, air hoists, concrete vibrators, line oilers, impact wrenches, etc. Several new products will be introduced.

■ **GATES RUBBER CO.**

V-belts and hoses will be exhibited, and Gates complete line of abrasion and corrosion products, particularly its new cold bond rubber, Vulcoline, will be demonstrated.

■ **GENERAL CABLE CORP.**

Will present all types of wires and cables for mining use, featuring Super Service mining cables with the new Supertuff jacket.

■ **GENERAL ELECTRIC CO.**
APPARATUS SALES DIVISION

Exhibit will highlight GE products and services. Some of the products featured for both open-pit and underground mining will be d-c motors and generators, a-c motors, controls, transformer, transportation equipment and wire and cable.

■ **GEODIMETER CO., THE**
A DIVISION OF BERG, HEDSTROM & CO., INC.

Description not available.

■ **GOODMAN MANUFACTURING CO.**

Plans to exhibit air compressors; conveyors and accessories; underground drilling and loading equipment, and both track and trackless haulage units.

■ **GOODRICH INDUSTRIAL PRODUCTS CO., B. F.**

Will exhibit hose, belting, rigid Koroseal products, rotor and stator units for Fagergren flotation machines, protective clothing, and other specialized products for the mining industry. A demonstration unit will show hose made by vertical braid method, as used in the manufacture of air, water and other long-length hose.

■ **GOULD-NATIONAL BATTERIES, INC.**
INDUSTRIAL DIVISION

The complete line of mine batteries will be on display, and all of the latest developments and improvements will be featured in each battery. Also, all of the components of the batteries will be on display for thorough examination.

■ **GRIPHOIST, INC.**

Plans to feature three products. A standard Griphoist with improved crankshaft and safety hook will be shown, as will a larger capacity unit, the Griphoist Model T-35. A 1000-lb capacity wire puller, will also be shown.

■ **H & L TOOTH CO.**

Will exhibit various sizes of teeth for mining equipment, featuring drop forged adapters with hammer forged heat treated replaceable points and their exclusive flexpin type connection. Exhibit will also have actual parts showing the development of the drop forged adapter from the billet stage to the finished product. Special feature will be the bulldozer corner adapters with replaceable points exhibited on a mock-up of a bulldozer blade.

■ **HARDINGE CO., INCORPORATED**

A small production model of the Overdrain classifier will be shown. Also on display will be new working models of the Tricone mill and the Electric Ear grinding mill control sound, with new sound recording chart.

■ **HARNISCHFEGER CORP.**

Electronic controls for P&H shovels will be in opera-

tion, and a cutaway section of the P&H Magnetorque along with the Magnetorque swing clutches and Dynamatic unit will be shown. Other products to be displayed include the P&H diesel engine, a diesel-powered generator, a gas-driven welder and a scale model of an overhead traveling crane.

■ ***HAWTHORNE, INC., HERB J.***

Will exhibit the new Blue Demon cone-type rotary rock bit, developed for minerals exploration and blast hole drilling, and the Blue Demon MP-200 Series replaceable blade insert bit for small hole rotary drilling in hard formations.

■ ***HERCULES MOTORS CORP.***

Description not available.

■ ***HERCULES POWDER CO.***

Dynatex, Hercules' new nitro carbo nitrate blasting agent, will be featured. Also included in the exhibit will be king-size cartridges, "timesaver" packages, a variety of blasting caps, and the blasting agents Hercomites and Gelamites.

■ ***HEWITT-ROBINS***

Main feature of the display will be a 20-ft section of the new "rope stringer" belt conveyor equipped with "hammock" idlers. Other products to be exhibited will include a 48 by 96-in. heavy-duty feeder, Style E-9, a speed reducer made by the Jones Machinery Division, infra-red car-thawing equipment, a Robintronic bin level indicator, and miscellaneous items in Hewitt-Robins' screen cloth, industrial rubber hose and conveyor belt lines.

■ ***HUGHES TOOL CO.***

An "inside look" at a Tri-Cone rotary rock bit, ball and roller bearings, bearing races, etc., will be a feature of this exhibit that shows the latest roller rock bits especially designed for air-rotary blast hole drilling. Also on display will be drilled rock, the Hugheset Aero-Jet Tri-Cone and other models of the latest designs of Aero and Aero-Jet Tri-Cones.

■ ***HUMPHREYS ENGINEERING CO.***

Pictures showing spiral concentrator installations and brochures on the spiral and its applications will be available.

■ ***INDUSTRIAL NUCLEONICS CORP.***

Will exhibit two new products recently introduced—the AccuRay Continuous Density Measurement System which measures and/or controls fluid density, specific gravity, percent solids, or related quantities, and the AccuRay Tank or Bin Level Systems.

■ ***INDUSTRIAL PHYSICS & ELECTRONICS CO.***

Description not available.

■ ***INGERSOLL-RAND CO.***

Among the equipment to be exhibited will be four sizes of the Downhole drill, a new dustless stoper, self-propelled drilling rig, Carset bits, carburized jackrods, jackbit grinders, tugger hoists, Impactools, sump pumps, air cranking motors, mine dewatering pumps and stationary compressors.

■ ***INTERNATIONAL HARVESTER CO.***

A "live" demonstration of the International Drott Four-In-One Skid-Shovel will be featured. Other equipment to be shown includes the TD-24 crawler tractor with a tilt dozer and P-29 power control unit, a Model 95 off-highway Payhauler and an International Drott TD-6 Four-In-One. Also featured will be a cutaway of International's new V-8 carbureted engine, model V-549.

■ ***INTERNATIONAL NICKEL CO., INC., THE***

Objective of Inco's exhibit is to emphasize the company's technological progress, its scholarships for geologists, mining and metallurgical engineers and its films on the mining, smelting and refining of nickel ores. A second objective will be to depict the many uses of nickel and nickel alloys in the mining industry.

■ ***IOWA MANUFACTURING CO.***

To be announced and displayed for the first time will be the Cedarrapids single impeller impact breaker. In addition, a Cedarrapids horizontal vibrating screen will be in operation and visitors will be able to see the material screened and watch the action of the horizontal type screen.

■ ***JAEGER MACHINE CO., THE***

Jaeger will display two sizes of its line of electric driven, rotary, two-stage, oil cooled, sliding vane, stationary compressors. The two models will be complete with magnetic reduced voltage starters, constant speed control and air receivers. A 365 cfm rotary portable compressor will also be shown along with Sure-Prime mine pumps.

■ ***JEFFREY MANUFACTURING CO., THE***

A new 30 in. wide rope belt conveyor will be shown. Other equipment to be displayed include a Rock Buster for reducing hard friable material; magnetic separator for wet concentration and magnetic recovery; electric vibrating feeders for regulating rate of feed; an air operated jig for concentrating ores, as a final concentrator or a rougher ahead of flotation; an Aerodyne fan for general ventilation, and a blower for delivery air to remote places.

■ ***JOHNSON-MARCH CORP., THE***

Equipment especially developed for the control of fine dust will be exhibited. These will include a Johnson-March Chem-Jet dust control system, Type A Hydro-Precipitator scrubber and the new Chem-Jet Verticone conditioner.

■ ***JOY MANUFACTURING CO.***

Will exhibit several new products for the first time. Equipment to be shown in operation includes a new rock drill with a type of power never before used; a new Joy Drillmobile mounting two new types of drill-jibs or power-operated remote controlled rock drill mountings; and a gasoline driven, diamond, core drill. Joy will also display its new "in-the-hole" drill; a diamond core and blasthole drill, and a new, automatic, air-powered drill carrier. Other products to be shown include the new line of air and electric driven shovel loaders and mine dozers; the Joy-Microdyne; new designs of scraper sheaves; air-leg drills; rock bits; a new six in. diameter blast-hole drill; a 75-hp slusher, and new air motors. A Joy Axivane mine fan and other metal mine products will also be on display.

■ ***KW-DART TRUCK CO.***

Will have on display a 50-ton tandem end dump truck powered by a 12-cylinder Cummins diesel engine and a tractor and trailer earth mover having a payload capacity of 128,000 lb. KW-Dart will also exhibit one of the first units built by them, a 1903 model that is in perfect operating condition. Other products to be exhibited include a small haulage unit that is dieselized and equipped with air scrubbers for underground usage and the new Borg-Warner four-speed transmission-converter unit. Cutaway views and working models of the clutches will be displayed.

■ ***KENNAMETAL INC.***

Will have on display its complete line of carbide mining tools. Special emphasis will be placed on rock drilling bits—both rotary and percussive. In addition, Kennametal will introduce a line of hardfacing materials which utilize hard, wear-resisting tungsten carbide.

■ ***KOEHRING CO.***
KOEHRING DIVISION

Will feature a six-cu yd capacity off-road hauling unit.

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Koehring also plans to show one of their Ka-Mo boring machines.

■ **L. & M. RADIATOR SERVICE, INC.**

Description not available.

■ **LE ROI DIVISION**
WESTINGHOUSE AIR BRAKE CO.

Will feature rock bits and several new or modified pieces of drilling equipment. In addition, a large stationary air-cooled compressor will be shown.

■ **LESCHEN WIRE ROPE DIVISION**

H. K. Porter Co., Inc.
See Porter Co., Inc., H. K.

■ **LETOURNEAU, INC., R. G.**

After a five-year absence from earthmoving and mining, will have the first public showing of a new self-loading electric wheel scraper. Having a capacity of around 60 tons, it features an electric motor in each wheel.

■ **LETOURNEAU-WESTINGHOUSE CO.**

Will introduce its LW-27 "Hydrair" truck to the mining industry. Ranging in capacity from 22 to 32 tons, these rear dump haulers possess a unique suspension system which makes possible greater tonnages on a shorter wheel base while maintaining a low center of gravity.

■ **LINK-BELT CO.**

Material handling equipment and power transmission components for the metal mining industry will be featured. On display will be belt conveyor idlers, a parallel shaft gear reducer and allied power transmission and materials handling products.

■ **LONGYEAR CO., E. J.**

Will feature the Model "44" diamond core drill for deep hole drilling. In addition, a new, lighter Wolverine air drill, diamond bits, and several sizes of the Longyear Wire Line Core Barrel will be on display. A section of the exhibit will be devoted to the use of photogeology.

■ **LOS ANGELES BY-PRODUCTS CO.**

See Los Angeles Steel Casting Co.

■ **LOS ANGELES STEEL CASTING CO.**

Will join with Los Angeles By-Products Co. in exhibiting wear-resistant liners and corrosion-resistant castings used as replacement parts in the mining industry. Also featured will be precipitation iron for use in copper leaching and precipitation.

■ **LUDLOW-SAYLOR WIRE CLOTH CO.**

Along with its subsidiary, Star Wire Screen & Iron Works, Inc., will have on display samples of abrasion-resistant corrosion-resistant and heat-resistant square-opening and long-opening woven wire screen and square-mesh and long-mesh grades of industrial wire cloth.

■ **MACHINERY CENTER, INC.**

Plans to exhibit a crawler mounted air powered front end loader for underground use, and a high capacity, non-blinding, high frequency vibrating screen. A visual presentation will show the vertical and incline Cryderman Shaft Muckers and the Whup-D-Whup train loading machine.

■ **MACK TRUCKS, INC.**

Will feature a new front-wheel drive off-highway truck. The unit is powered by a turbocharged 205-hp diesel engine and has a GVW rating of 55,000 to 65,000 lbs. Mack will also exhibit a 22½-ton dump truck.

■ **MACWHYTE WIRE ROPE CO.**

Will have on display various wire ropes for mining equipment including preformed and internally lubricated wire rope, braided wire rope slings, and cable assemblies. Featured will be hand samples of wire rope materials for close study.

■ **MANCHA STORAGE BATTERY LOCOMOTIVE DIVISION**

Goodman Manufacturing Co.

A 1½-ton storage battery locomotive and a 2-ton diesel locomotive will highlight the exhibit. Also to be displayed is a section of Goodman Ropebelt conveyor.

■ **MANNING CO., CHARLES E.**

Display will consist of groove type couplings and fittings for use with all types of grooved-end pipe. A new coupling which can be used on light wall aluminum, steel or spiral weld pipe and tubing will be introduced.

■ **MARION POWER SHOVEL CO.**

Will feature an animated and photo display of various Marion shovels ranging in size from 6 to 60 cu yd dipper capacities.

■ **MINE SAFETY APPLIANCES CO.**

For mine lighting, electric cap lamps with automatic low voltage charging equipment and MSA fluorescent light fixtures will be featured. Electronic equipment to be shown includes transistorized audio tone transmission for remote control of fans, substations, etc., and MSA Minephones in conjunction with audio equipment and closed circuit television. With other respiratory and breathing apparatus, the McCaa two-hour apparatus with full vision facepiece will be on display.

■ **MINING CONGRESS JOURNAL**

Official publication of the American Mining Congress invites foot-weary visitors to "set and rest." The exhibit will feature MCJ's service for the entire mining industry.

■ **MINING WORLD**

Will have a complete display of Mining World and World Mining, featuring domestic and foreign coverage.

■ **MISSION MANUFACTURING CO.**

Featured will be Mission's Hammerdril and Hammerbit, a bottom-hole impact drilling tool designed for high speed, low cost drilling of hard formation using air as a medium. Also shown will be Mission's complete line of reciprocating pump parts, centrifugal pumps and automatic lubricated valves.

■ **MOBILE DRILLING, INC.**

A drill specifically designed to do augering, core drilling and large diameter earth boring will be displayed. This unit can be used for continuous flight augering to 75 ft, coring to 500 ft and for boring holes up to 24 in. in diameter.

■ **NAGLE PUMPS, INCORPORATED**

Exhibit will emphasize pumps for abusive applications in ore preparation plants. Pumps for handling both abrasive and corrosive liquids will be shown in operation, including a vertical cantilever-shaft unit which has no stuffing box nor submerged bearings. Another unit in operation will be an automatic priming pump.

■ **NATIONAL FILTER MEDIA CORP.**
WESTERN DIVISION

Will feature its new Trilok filter drainage material, and an improved woven plastic designed to replace screens, rubber grids, slats, etc., in filter and dust collector construction. Also on display will be a wide variety of filter media and filter paper.

■ **NATIONAL MALLEABLE AND STEEL CASTINGS CO.**

An electronically monitored demonstration of impact forces developed in mine car structures will be featured. Other items on display will include automatic pumpers, mine car trucks, rubber-cushioned devices, railroad-type couplers, grinding balls, mill liners and miscellaneous castings manufactured for the mining industry.

■ **NATIONAL SUPPLY CO.**

Will display a heavy duty industrial torque converter for application on large mining and earthmoving equipment in the 100 to 1000-hp classification.

■ **NEVADA DEPARTMENT OF ECONOMIC DEVELOPMENT**

To give publicity to the one hundredth anniversary of the discovery of silver in Virginia City, Nev., a prospector and his burro will be on display.

■ **NORDBERG MANUFACTURING CO.**

Working models, photographs and movies are planned to show design features of Nordberg's drum and friction type mine hoists and grinding mills, primary gyratory crushers, cone crushers, screens and bar and rod grizzlies.

■ **NORTHWEST ENGINEERING CO.**

Will use photographs to feature its services to the mining industry.

■ **OHIO BRASS CO.**

Display will include cable fault locators, and a complete display of overhead trolley wire fittings, connectors and fittings for aluminum or copper feeder cables, and rail bonds. Current collectors for locomotives, fused trolley taps, ground clamps, and expansion shells and plugs for roof bolting will round out the exhibit.

■ **OLIN MATHIESON CHEMICAL CORP.**
EXPLOSIVES DIVISION

Will feature the complete line of Olin explosives.

■ **ORE & CHEMICAL CORP.**

Exhibit will feature a working model of a Heavy-Media separatory vessel.

■ **OSHKOSH MOTOR TRUCK, INC.**

Description not available.

■ **PIONEER ENGINEERING**
DIVISION OF POOR & CO.

Will exhibit a newly-developed intermediate size jaw crusher having a 20 by 36-in. feed opening and capable of reducing material to three in. Also on display will be Pioneer's method for secondary suspension of vibrating screens.

■ **PIT AND QUARRY PUBLICATIONS**

Display will illustrate the industries covered by Pit and Quarry. Literature and market information showing application of equipment used in the industry will be available.

■ **PLASTIC WIRE & CABLE CORP.**

Plans to feature damage-resistant and flame-resistant trailing cables, flexible cords and shot firing wire.

■ **PLUMMER CO., WALTER A.**

Will have on display a line of filter fabrics and filter bags plus various other canvas products. Also shown will be a flat tape with a zippered closure bead for use as a jacket that can be zipped around hoses, pipes, electrical cables, etc., to provide an abrasion-resistant, chemical-resistant, waterproof jacket.

■ **PORTER CO., INC., H. K.**
LESCHEN WIRE ROPE DIVISION
QUAKER RUBBER DIVISION

Leschen will have on display numerous samples of various types and constructions of its line of wire rope used in mining operations. Also to be shown will be a number of wire rope slings.

■ **PRODUCTIVE EQUIPMENT CORP.**

Will show a 4 by 10-ft double deck vibrating screen for service either in inclined screening of dry materials or flat operation, and in some instances uphill operation in dewatering slurries.

■ **QUAKER RUBBER DIVISION**
H. K. PORTER CO., INC.
See Porter Co., Inc., H. K.

■ **RAYBESTOS-MANHATTAN, INC.**
MANHATTAN RUBBER DIVISION

Will feature its new Poly-V-Drive, its latest development in power transmission. Also to be featured are the company's conveyor belt developments and its line of hose and industrial rubber products.

■ **RED JACKET CO., INC.**

Plans to have a four-in. valve in operation showing the principle of operation and advantages of the valve on slurries. Sleeves of various material and construction will be on display.

■ **REICH BROS. MANUFACTURING CO., INC.**

Will feature a combination rotary and down-the-hole drill. The model T-750, mounted on an over-the-highway truck, has a capacity of up to 40,000 lb down pressure for rotary drilling. A lightweight crawler mounted self propelled combination rotary, percussion and down-the-hole blast hole unit will also be shown.

■ **RIDGE TOOL CO.**

Will introduce four new pipe tools—a three-wheel tubing cutter designed especially for easy cutting of hard-to-get-at tubing with just quarter turns; a portable tristand top-screw chain vise; a 4 to 6 in. geared pipe threader and a newly-designed hexagonal wrench.

■ **ROCK PRODUCTS MAGAZINE**

Will feature noteworthy facts about the mining market and new products that have been developed for the industry.

■ **ROEBLING'S SONS CORP., JOHN A.**

Exhibit will highlight its regular line of wire rope and its new dual-purpose construction, Herringbone wire rope. In addition, electrical wire and cable for industrial, mining and utility requirements will be shown.

■ **RUST-OLEUM CORP.**

Will feature rust preventive coatings in all colors and variety of types for use in industry.

■ **SANFORD-DAY IRON WORKS, INC.**

Will show Gismo equipment featuring a rubber-mounted Gismo unit and a new power unit. Automatic bottom-dumping cars as well as other types of mine cars will also be shown.

■ **SCHRAMM, INC.**

Description not available.

■ **SIKA CHEMICAL CORP.**

Plans to feature the Perfo roof bolting system in which rock bolts are grouted into the bolt hole. Also shown will be quick-setting compounds and plastiment retarding densifiers used for slowing down the initial set of concrete.

■ **SIMPLEX WIRE & CABLE CO.**

Will feature new company products designed to meet the more rigorous conditions of today's mining operations. Also on display will be samples of new sheathed cable for electrical supply, distribution and control circuits in all environments.

■ **SKOOKUM CO., INC.**

Plans to have on display a complete line of mining blocks and accessories.

■ **SMIDTH & CO., F. L.**

Engineers and manufacturers of rotary kilns and grinding mills, the company will exhibit two operating scale models. One is a typical rotary kiln with an integral cooler such as used for treating cement lime, dolomite, magnesite, ore, etc. The other is a ball mill driven directly through one of the mill trunnions, eliminating open gear and pinion drive.

■ **SOUTHWESTERN ENGINEERING CO.**

Will feature its integrated line of engineering and construction services, as well as equipment, for the mineral industries. Highlighted will be the Krupp-Renn process for the direct reduction of iron ores and a vibrating screen separator for accurate classification.

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■ **SPENCER CHEMICAL CO.**

Theme of the exhibit will be the use of prilled ammonium nitrate for lowering blasting costs. The exhibit will be designed to assist open-pit operators in developing a blasting program to make the greatest use of ammonium nitrate.

■ **STANCO MFGS. & SALES, INC.**

Will feature a demonstration model of its Flygt Submersible Pump.

■ **STANDARD STEEL CORP.**

Display will feature photographs of dryers, coolers, kilns, calciners, and special rotary equipment from mines and refineries around the world. Scale models will be used to show design features in sawtooth lifters, and dryer parts such as trunnions, seals, gears, etc.

■ **STEARNS MAGNETIC PRODUCTS**

Exhibit will highlight a permanent magnetic pulley with a new radial-pole design which permits it to be used for deep conveyor burdens which previously could only be handled by electro-magnetic pulleys. Other magnetic equipment on display will be a grate magnet for installation in hoppers, chutes, ducts or floor openings; and a new, extra-thin plate magnet for use in inclined chutes, spouts, or on conveyors.

■ **STEPHENS-ADAMSON MANUFACTURING CO.**

Description not available.

■ **STOODY CO.**

Will have in continuous operation an automatic welding head, a semi-automatic welder with positioner and turning device for small parts and a semi-automatic welder used as a substitute for an ordinary manual hard-facing method. In addition, a variety of hard-faced mining equipment parts will be on display.

■ **STRATOFLEX, INC.**

Description not available.

■ **THERMOID CO.**

Display will feature conveyor belting, chute lining, multiple v-belts, and several types of hose used in the mining industry.

■ **THOMAS FLEXIBLE COUPLING CO.**

Will feature its line of heavy duty flexible couplings especially designed for tough applications such as crusher drives, ball or rod mill drives, etc.

■ **THOR POWER TOOL CO.**

Will feature hand-held, automatic and mobile air-operated rock drilling equipment. New equipment will include the company's dustless rock drills, both automatic push-feed and hand-held, complete with dust-extraction units.

■ **TIMKEN ROLLER BEARING CO.**

Highlighted at the Timken exhibit will be tapered roller bearings, removable rock bits and alloy steel used in the metal mining industry.

■ **TOOL STEEL GEAR AND PINION CO.**

Exhibit will feature the various types of materials manufactured for the mining industry by the company. Cutaway samples will show the depth of hardened surface and the core of the part offered for service in the mining industry.

■ **TRAYLOR ENGINEERING & MANUFACTURING CO.**

Will use large photographs to feature its kilns, jaw crushers, reduction crushers, feeders and gyratory crushers.

■ **TWIN DISC CLUTCH CO.**

Will exhibit a complete line of mechanical power transmission items. In addition to mechanical air and hydraulic clutches, working models of both fluid couplings and hydraulic torque converters will be shown. Cutaway working models will be used to demonstrate the path of fluid circulation.

■ **TYLER CO., THE W. S.**

Featured will be the latest model Ty-Rock screen used in the mining industry. Samples of woven wire screens of many metals and meshes, along with standard screen scale testing sieves, will complete the exhibit.

■ **UNION WIRE ROPE CORP.**

Will feature the Tuffy line of wire rope products. In addition to dragline rope, scraper rope, hoist rope, dozer ropes, and wire rope slings, complete reels of wire rope will be shown.

■ **UNITED STATES RUBBER CO.**

Exhibit will feature U. S. Rubber products for use in the mining industry. Included will be asbestos rubber sheet packings, electrical tape, conveyor belts, pilot flexible pipe, leaching hose, corrosion resistant pipe, and a new dacron fire hose.

■ **UNITED STATES STEEL CORP.**

Exhibit will show the role played by high strength and alloy steels in providing mining equipment longer life, greater pay load and more efficient operation. Also on display will be working models of self-aligning conveyor idlers, wire rope and electrical cables.

■ **UNIVERSAL ENGINEERING CORP.**

Will exhibit its self-cleaning wobbler feeder, which removes fines and moves the oversize forward, and a two deck vibrating screen.

■ **VAREL MANUFACTURING CO.**

Exhibit will feature a new small Rotary Bit, and new Star designs in diamond drilling and coring bits. In addition, a wide variety of rotary and diamond core bits will be displayed.

■ **VASCOLOY-RAMET CORP.**

Plans to have a complete line of carbide tipped rock bits on display. Two new items, including a new eight-in. carbide tipped percussion bit especially designed for burnhole drilling and a series of three or four diameters of push-on chisel point detachable bits will be shown.

■ **VICTAULIC, INC.**

Highlighted will be the Victaulic method of piping, standard couplings, Snap-Joint couplings, portable tools for cutting grooves in standard weight pipe, fittings for grooved pipe and couplings, through 12 in., for plain end pipe.

■ **VULCAN IRON WORKS CO.**

Exhibit will consist of an operating model material hoist and a small semi-automatic service hoist installation. A model skip-cage unit and an inclined skip will be used. A 20-hp slusher hoist will also be shown.

■ **WEDGE WIRE CORP.**

Plan to feature Wedge Wire screens in different wire sizes, shapes, and materials. Featured will be a new T-Wedge screen designed to combine small wire efficiency with large wire economy where large material and high abrasion application are a factor.

■ **WESTERN GEAR CORP.**

Exhibit will feature Western Gear's StraitLine gearmotors and Speed Master speed reducers. Another attraction will be the Sky-Climber, a lightweight hand-or-motor operated cable hoist.

■ **WESTERN INSULATED WIRE CO.**

Will have on display both round and flat twin parallel Neoprene trailing cables. Also shown will be control cables and high voltage cables.

■ **WESTERN MACHINERY CO.**

Will display a 5 by 16-ft Wemco-Remer jig and a four cell Fagergren flotation machine. New additions to the company's line of products will also be exhibited.

■ **WESTERN ROCK BIT MANUFACTURING CO.**

Will show a wide variety of drill bits manufactured for the mining industry. Featured will be single-pass steel bits, single-pass tungsten carbide insert bits and taper socket bits.

■ **WESTFALL EQUIPMENT CO.**

Will show film of Westfall tractors at work in mining operations.

■ **WESTINGHOUSE ELECTRIC CORP.**

Display will feature motors, controls, transformers, gearing and electrical apparatus repairs and services provided by the company.

■ **WHEELABRATOR CORP.**

Two cloth-type dust collectors will be on display. The larger model will be cut away to illustrate the operating mechanism and the various types of cloth Dustubes used, depending upon the chemical properties, temperature, etc., of the dust and fume encountered. The small collector will be partially constructed of plastic to illustrate the action of the filter during operation.

■ **WHITE MOTOR CO.**
AUTOCAR DIVISION

Shown will be a 25-ton off-highway rear dumper, powered by a 335-hp diesel engine with torque converter, a direct drive lock-up, four speed planetary transmission and Torqmatic brake.

■ **WILD HEERBRUGG INSTRUMENTS INC.**

Plan to exhibit precision made optical transits and Theodolits. Of special interest is an optical transit which features extremely convenient reading by means of scale microscopes. Attachments include battery box for illumination of circles, reticules and level vials for underground use.

■ **WILLYS MOTORS, INC.**

Exhibit will be built around the Willys Universal Jeep and the Willys Jeep Station Wagon. Newest models of these four-wheel drive vehicles will be shown, equipped for use in exploration, drilling and other off-road operations.

■ **YUBA CONSOLIDATED INDUSTRIES, INC.**

Will show a working model of a bucket ladder dredge, two jig metal concentrators and an earth mover. All equipment will be in operation and spectators can control the ejection lever of the earth mover.

Sponsors

(Not exhibiting, but actively supporting the Mining Show)

ANACONDA WIRE & CABLE CO.
APACHE POWDER CO., INC.
BIRD MACHINE CO.
CANADIAN INDUSTRIES LIMITED
DOWTY MINING EQUIPMENT LIMITED
EDISON INDUSTRIES, THOMAS A. STORAGE BATTERY DIVISION
FIRESTONE TIRE & RUBBER CO.
FLOUR PRODUCTS COMPANY SANTA FE TANK DIVISION
GAR WOOD INDUSTRIES, INC.
IRWIN FOUNDRY & MINE CAR CO.
KANSAS CITY STRUCTURAL STEEL CO.
LAKE SHORE, INC.
LUKENS STEEL CO.
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(Continued from page 53)

En route to San Francisco, mining men will have the opportunity to attend the AIME's Rocky Mountain Minerals Conference in Salt Lake City, September 17-19, and many visitors to the Mining Show will undoubtedly take a few days to see the many attractions of California and the Pacific Coast—some may even take a vacation trip to Hawaii!

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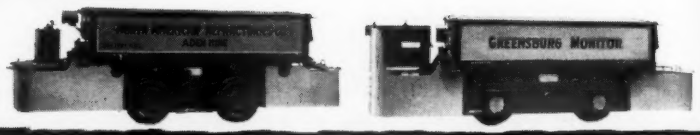
The outstanding general and technical sessions . . . the greatest exhibition of mining equipment yet . . . the opportunity to meet top Government and industry leaders . . . outstanding entertainment . . . special events—add all of these ingredients up and they spell out the industry's "big event" of the year—the 1958 Mining Show. You can't afford to miss it!

National Mine Service Company

GREENSBURG MINE LOCOMOTIVES



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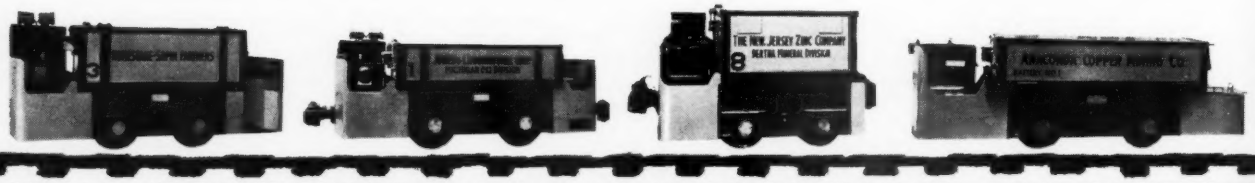

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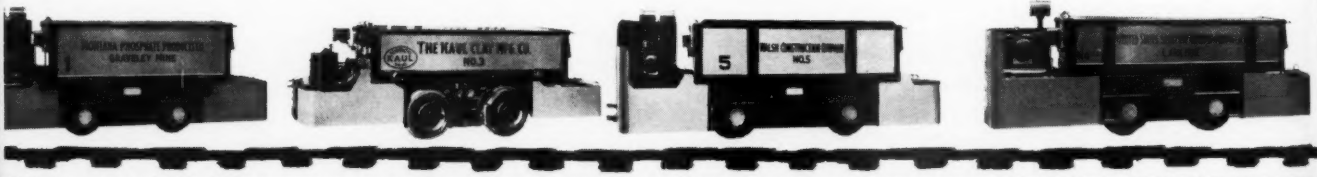
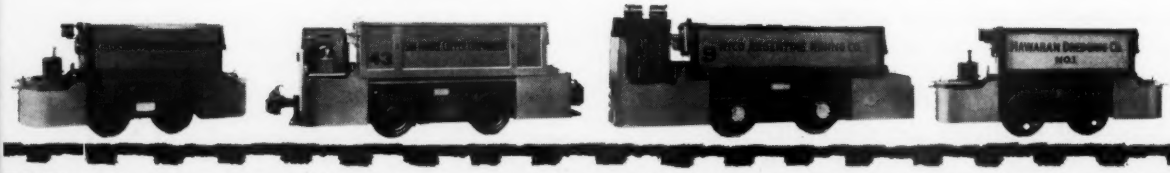


GREENSBURG MONITOR—a great name in mine locomotives—is now an integral division of NATIONAL MINE. The complete range of Greensburg Monitor Storage Battery Locomotives, from 2 to 15 tons, is backed by the service of National Mine in every major mining area. When you want *more pulling power per ton*, with longer battery life and higher efficiency for every invested dollar, check the facts with National Mine!



National Mine Service Company

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COAL DIVISION REPORT
Second of two parts

Characteristics of A-C Mining Equipment

By F. R. Hugus, R. C. Berger,
J. A. Buss and A. C. Lordi

Part II of this important report by the AMC Committee on Underground Power describes a-c motor controls, explains the importance of power factor and lists considerations that must be taken into account when engineering a mine for a-c operation

CHARACTERISTICS of the various a-c motors commonly used in mining equipment were outlined in Part I of this report which appeared in the July issue of *Mining Congress Journal* as did an outline of supplementary equipment available to partially absorb accelerating losses. This month the report first takes up a-c motor controls.

Control

FULL VOLTAGE STARTERS

Full voltage starting of a-c motors is desirable in order to obtain simplicity and economy in the starting equipment. Modern induction motors are designed to withstand the application of full voltage at standstill without damage to the motor windings. Unfortunately, polyphase squirrel cage motors inherently have full voltage accelerating currents high enough to produce objectionable voltage drop on weak power systems. This may result in an annoying light flicker if the system supplies both power and lighting circuits.

Other disadvantages to full voltage starting are (1) the sudden application of full voltage torque which may be sufficiently high enough to damage the mechanical drive or to be detrimental to the machine's load, and (2) voltage dips affecting apparatus other than lights which are connected to the power system. An example of the latter is where the voltage dip is sufficient to drop out the motor's own line contactor.

Power companies may have specific regulations governing the size of motors which may be started on full voltage. Frequently regulations specify the allowable starting current based on the horsepower rating of the motor. On the other hand, power companies may permit customers having large connected loads to start even their largest motors on full voltage.

REDUCED VOLTAGE STARTERS

There are three important reduced voltage starting methods for starting squirrel cage induction motors. These are (1) auto transformer method, (2) series resistor method, and (3) series reactor method.

Before examining the types of reduced voltage starting, a word about "starting torque efficiency" is in order because it is an important measuring stick for comparing the different types of starting. Torque efficiency is the ratio of starting torque in percent of full load torque to line current in percent of full load current, and as such is often called "torque per ampere." In short, "getting the mostest (torque) for the leastest (amperes)" during starting is called high torque efficiency. Full voltage starting gives maximum torque efficiency and the various forms of reduced voltage starting are evaluated in terms of it. While torque efficiency is desirable, it is not always essential.

An auto transformer starter consists essentially of an auto transformer and a switching arrangement which serves to connect a motor during starting to the auto transformer at a reduced voltage and then transfers it directly to the line for normal operation.

The auto transformer is provided with taps for starting the motor at 65 to 80 percent of line voltage. In sizes above 50 hp an additional tap may be provided for starting at 50 percent of line voltage. Auto transformers are designed for intermittent

duty and may not be left connected to the line after starting the motor, since the exciting current alone is sufficient to cause overheating on a continuous basis.

Switching from the auto transformer connection to the line connection may be done either manually or magnetically. The starting mechanism for the usual method consists of a five-pole magnetic contactor together with a three-pole contactor. The five-pole contactor is energized first. After the motor is accelerated, this contactor drops out and the three-pole contactor is energized thereby connecting the motor directly across the three phase line. It can be seen that during the starting period the motor is actually momentarily disconnected from the power source. Such action is known as "open transition" starting.

The Korndorfer method requires three-pole contactors in both starting and running positions and a separate two-pole contactor for connecting the wye point of the auto transformer. The "closed transition" method reduces the large transient current which may result when the line contactor is closed because the motor stays connected to the line through the reactance of the auto transformer between the start and run positions.

Remembering that the torque varies as the square of the voltage applied, it is easy to see that the 80 percent tap will produce 64 percent of the full voltage starting torque, whereas the 65 percent tap will give only 42 percent of the full voltage starting torque. This means that although the starting current will be reduced, acceleration time for a given load condition will be increased because the torque available for acceleration is reduced by the square of the voltage applied.

Note also that the motor starting current is proportional to the voltage applied to the motor terminals. The reduced *line* current at starting (on the power side of the auto transformer) will also be proportional to the square of the voltage. Therefore, since the starting torque, as well as the line current, are both proportional to the square of the voltage, the "torque efficiency" of an induction motor with the auto transformer method of reduced voltage starting is the same as for full voltage starting. This is one plus feature for the auto transformer method.

RESISTOR STARTING

With the resistor starting method, the motor is first connected to the line through a series resistor in each phase. The accelerating equipment consists of contactors for short circuiting the starting resistor. If this is done in several steps, it is possible to gradually increase the line current to the maximum value necessary to start the load. One step is usually sufficient. In this way the objectional transient characteristic associated with the usual method of auto transformer starting is avoided during the switching from start to run condition because, like with the Korndorfer method, the motor is never entirely disconnected from the power source.

While the reduced line current and motor starting current with resistor starting are proportional to the reduced terminal voltage, the reduced starting torque is proportional to the square of the voltage. Therefore, the "torque efficiency" for resistor starting is lower than for full voltage starting and it is proportional to starting current.

REACTOR STARTING

Reactor starting is used less often than either auto transformer or resistor starting, but the method possesses some desirable characteristics which make it attractive in certain applications. It is similar to resistor starting and may utilize the same switching arrangement. However, it is not possible to short-circuit the reactor in several steps as in the resistor starting method unless the winding for each step is segregated on a separate core.

In both resistor and reactor starting, the voltage at the motor terminals increases as the motor comes up to speed. In the case of the resistor starter, the voltage drop across the resistor decreases because the inrush current decreases as the motor comes up to speed. In the case of reactor starting, this increase in voltage as the motor comes up to speed is the result of the change in motor impedance with increasing speed. In the reactor starting method, the increase in terminal voltage as the motor approaches synchronous speed is greater than in the resistor starting method. In the reactor method, the voltage across the reactor swings out of phase with the terminal voltage of the motor as the motor power factor increases to or near full speed.

Torque efficiency under reactor starting varies with the reduction in voltage in the same manner as in the resistor starting method; that is, proportional to starting current.

SAMPLE CALCULATIONS—STARTING TORQUE EFFICIENCY

"TORQUE EFFICIENCY"

Assume NEMA Design B Motor rated 100 hp, 1800 rpm, 242 ampere, 220 volts, 3 phase, 60 cycle capable of developing 125 percent starting torque with full voltage applied at the terminals. Locked rotor current equals 1450 amperes.

$$\text{Full load torque} = \frac{\text{hp} \times 5250}{\text{Speed}} = \frac{100 \times 5250}{1800} = 292 \text{ ft lb}$$

$$\text{Starting torque} = 1.25 \times 292 = 365 \text{ ft lb}$$

Torque efficiency (full voltage start)

$$= \frac{365}{1450} = 0.252 \text{ ft lb/ampere}$$

AUTO TRANSFORMER STARTING

Starting torque and line current both vary as the square of the applied voltage. Assume auto transformer top at 65 percent voltage.

$$\text{Therefore, starting torque} = 365 \times (0.65)^2 = 365 \times 0.42 = 153 \text{ ft lb}$$

$$\text{and starting current} = 1450 \times 0.42 = 608 \text{ amperes} = 1450 \times (0.65)^2$$

$$\text{Torque Efficiency} = \frac{153}{608} = 0.252 \text{ ft lb/ampere}$$

(Auto Transformer) (65% top)

RESISTOR OR REACTOR STARTING

Starting torque varies as the square of the applied voltage, whereas line current varies directly with the applied voltage. (See text.) Again assume 65 percent standstill voltage.

$$\text{Starting Torque} = 365 \times 0.42 = 153 \text{ ft lb}$$

$$\text{Starting Current} = 1450 \times 0.65 = 942 \text{ amperes}$$

$$\text{Torque Efficiency} = \frac{153}{942} = 0.1625 \text{ ft lb/ampere}$$

(Resistor or Reactor 65% standstill volts)

MULTI-SPEED SQUIRREL CAGE MOTOR STARTERS

In the case of multi-speed induction motors, external magnetic contactors are used to switch the winding connections in order to provide for the various speed conditions.

WOUND ROTOR MOTOR STARTERS

Full voltage line contactors are normally used with wound rotor motors. Reduction in starting torques and starting current can be more easily accomplished by switching resistance in the secondary of the wound rotor motor. In many cases manually operated drum switches are used in the secondary circuit. This is usually the case when the motor is used on an adjustable speed application. On a starting duty only type of control secondary switching may be controlled automatically by magnetic contactors for switching the elements of the external resistor connected to the rotor circuit. Starting current can be reduced to any desired value and 1.5 times full load current is often selected.

The expense of this type of control prevents its wide application, even though flexible starting characteristics can be attained. Nevertheless, where the starting current restrictions are unusually severe, it is often considered and may be the only means of meeting a particular limitation.

SPECIAL METHODS

There are many other types of starting methods, such as part winding starting, wye-delta starting, and series parallel phase winding connections. These systems are mentioned only since they are of little commercial importance because the starting equipment is not a great deal less expensive and the resulting starting torques are so low that the system does not give good general purpose application possibilities.

SYNCHRONOUS MOTOR STARTERS

Since the d-c excited rotor poles on a synchronous motor are only capable of producing a positive average motor torque when the motor is synchronized, these poles are useless in starting a motor from rest. To achieve starting, there is inserted in the rotor pole faces of the synchronous motor a squirrel cage winding sometimes called the "starting winding." Thus, during the starting period a synchronous motor operates exactly as a squirrel cage induction motor. Power is supplied to the stator only and the current induced in the starting winding produces the accelerating torque. The torque produced at various speeds follows a curve which, as would be expected, is similar to the general shape of the speed torque curve of a squirrel cage induction motor.

The discussion of induction motor starting above applies equally well to synchronous motors. However, the choice of a starting method for a synchronous motor may differ from choice of a starter for a similar induction motor because of differences in motor torque, mechanical and electrical construction, load inertias, and the specific application.

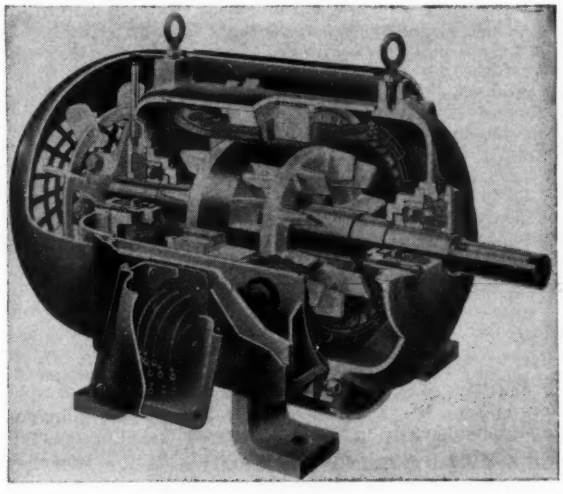
In addition to the control equipment necessary to connect the synchronous motor to the power system, there is also the need for field application and field removal control components. The synchronous motor is first accelerated to about 95 percent of synchronous speed on its starting winding, in a manner similar to the way an induction motor is started. At this point it is necessary to apply the d-c field to its source of power at precisely the right angle (near zero degrees) to cause the motor to pull into synchronism.

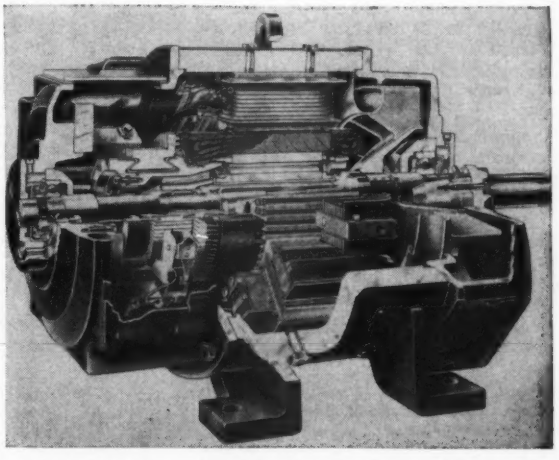
By the same token, good field removal when the motor pulls out of synchronism due to heavy loads in excess of pull-out torque is just as important as proper field application. There are many methods used to apply and remove field; however, it is not the purpose of this report to compare methods because these methods differ with the various control manufacturers. Suffice it to say, all methods are expected to apply field and remove field at the correct position of the rotor with respect to the rotating magnetic field in the stator winding of the synchronous motor.

PROTECTIVE FEATURES

In addition to the circuitry required for connecting a-c motors to the power system, the a-c motor control in most instances provides protective features such as short circuit protection to the motor. This protection can be provided for by either manually operated or electrically operated power circuit breakers. In some cases short circuit protection can be provided by both low and high voltage fuses of standard or current limiting types.

In addition to short circuit protection, standard a-c motor controls usually provide overload protection. This is commonly in the form of inverse time delay relays which consist of bimetallic strips that are heated by a thermal heater. The thermal heater carries motor current and, therefore, is a measure of current in the motor and, hence, these relays are often referred to as thermal overload relays. Induction disc type relays, which are truly inverse time current relays, are





Major advantages offered by an a-c motor are simpler and more rugged construction. This is obvious from comparing a cutaway view of an a-c motor (left) with that of a d-c motor (above)

often used on large induction and synchronous motor starters. These relays, although they attempt to simulate motor current, cannot offer full protection since the temperature sensitive element may not be in the same ambient temperature as the motor itself.

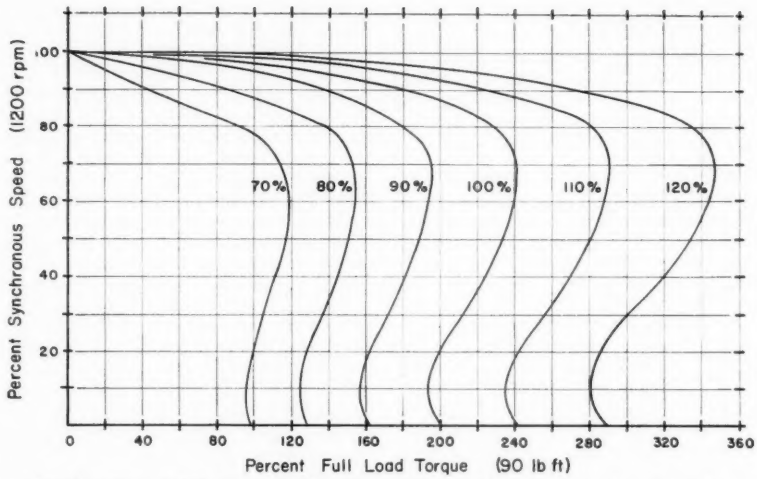
To overcome this shortcoming, resistance temperature detectors are often embedded in the coil slots of the motor to obtain a true reading of motor temperature. These devices are used primarily on the larger motors. On smaller motors, devices are used to measure motor temperature directly. All of these sensing devices ultimately cause the motor to be disconnected from the line in order to protect the machines from an overload condition which may in time burn out the motor. Temperature measuring devices have been used occasionally in mining machine motors but have not enjoyed broad application. They can be shorted out easily and this condition is difficult to detect during routine inspection.

Reverse power relays, phase sequence relays and ground sensing relays are usually only applied to large a-c motors, say above 1500 hp, where insurance on a very large investment is warranted.

A. **Reverse current relays** are merely polarized over-current relays. They are equipped with a voltage coil to measure the direction of current. As long as the current flow is in the correct direction, the relay contacts remain closed. If for any reason the motor suddenly becomes a generator, the relay contracts open and shut down the motor.

B. **Phase sequence relays** provide open or reverse phase protection. The relay is composed of three principal parts; (1) a set of four series coils, (2) an armature, and (3) a contact mechanism. Coils are grouped in two pairs, with one pair connected in each of two power lines. The armature consists of a copper disc pivoted at its center and mounted directly in front of the coils.
Phase conditions in a normally operating power phase system are such that a rotating magnetic field is set up causing the armature disc to rotate in a clockwise direction until it strikes a stop on the frame. A reversal of phase in the power system, or a failure of one of the phases, reverses the direction of the resultant magnetic field and causes the armature to rotate in a counter-clockwise direction tripping a set of normally closed contacts.

C. **Ground sensing relays** are overcurrent relays designed to detect very small magnitudes of current. They are sometimes connected in the residual circuit of three single phase current transformers connected in wye. More recently, the development of Buytal molded current transformers with large windows makes it possible to run all three motor leads of a three-phase motor through the window of one current transformer (CT). The ground relay is then connected to the secondary of the current transformer. Under normal conditions, the phase currents are balanced and the relay sees no current. Even if there is an unbalance in the three-phase circuit the net current through the CT is still zero. However, if a ground should develop in the motor, the net current in the three phases is no longer zero. The CT then develops a signal and the relay opens the control circuit to the motor. This latter scheme is much more accurate than the residual circuit connection.



Speed-torque variations in relation to percent voltage change. In the motor illustrated by this curve, 100 percent torque is available at 77.5 percent synchronous speed and 70 percent voltage, or at 87.5 percent speed and 80 percent voltage, or at 97 percent speed and 100 percent voltage, or at 99 percent speed and 120 voltage, etc

In summary, then, control equipment is used to connect the motor to the power source and, after once connected, it must monitor the performance of the motor and disconnect it from the power source, thereby protecting it from short circuit currents, ground fault currents, overload currents, and over-temperature conditions. Protective features of the control equipment act as "watch dogs" to protect the initial investment in the motor.

Power Factor

WHAT IS IT?

There is one term that is often used in discussing a-c motors that never comes up when discussing d-c motors. This is the term "power factor." It has been used many times in our discussion of the performance characteristics of a-c motors, but just what is it?

The simplest non-technical definition for power factor may be likened to "the foam on a glass of beer." "It's something you pay for and never receive."

Technically speaking, power factor may be expressed as the ratio of the power producing current in the circuit to the total current in the circuit. Referring to our glass of beer, when you step up to the bar, you pay for the whole glass. The "power producing" portion is the liquid and, even though he pays for the entire glass, the consumer gets little or no "kick" from the foam.

When the power company measures the quantity of electricity that the mine may consume, it measures total current. Some of this current is power-producing and some of it produces no work. This is known as wattless power. Again, referring to the glass of beer, the foam is the wattless power.

Current required by induction motors may be considered to be made up of two separate kinds of current; magnetizing current and power-producing current. Power-producing current is that current which is converted into useful work. The unit of measurement of the power produced is the kilowatt. Magnetizing current, also known as wattless, reactive or non-working current, is that current which is required to produce the flux necessary for the operation of an induction motor. Without magnetizing current, energy could not flow across the air gap of the induction motor. The measurement of magnetizing volt amperes is the kilovar.

Total current is that current that would be read on an ammeter in the circuit. It is generally made up of both magnetizing current and power-producing current which, like a glass of beer is made up of the liquid and of the foam. The unit of measurement of total volt amperes or "apparent power" is known as kilovolt-amperes.

There is one small difference in our analogy. In the glass of beer the liquid (kilowatts) plus the foam (kilovars) equals the total glass (kilovolt-amperes). In the case of power factor, kilowatts must be added vectorily, and not arithmetically, to kilovars to obtain kilovolt-amperes. To be added vectorily, the kilovolt-amperes is equal to the square root of the sum of the square of the kilowatts plus the square of the kilovars. In the case

of the glass of beer, eight units of beer plus six units of foam equals a total of fourteen units. In dealing with power factor, eight units of kilowatts plus six units of kilovars equals ten units of kilovolt amperes. That is, the square root of 6^2 (36) plus 8^2 (64) equals the square root of (100) or 10.

In this case, power factor equals eight divided by 10 or 80 per cent. Stated another way, the power factor is that factor by which the apparent power must be multiplied in order to obtain the working power, or 10 KVA (apparent power) multiplied by 0.8 equals eight kilowatts (working power).

The terms "leading" and "lagging" power factor are apt to be confusing and they are meaningless unless the direction of both kilowatt and kilovar flow is known. Generally, however, in mines or industrial plants only the load power factor is considered, in which case the following rule may be helpful in differentiating between leading and lagging power factor: "The power factor is lagging if the load requires kilovars and leading if the load furnishes kilovars." Thus, an induction motor has a lagging power factor because its magnetizing requirements must be supplied from the power supply or other sources. On the other hand, a synchronous motor can supply kilovars (from the motor d-c field action) so a synchronous motor can have leading power factor.

HP	Percent Efficiency A-C	D-C
7½	85	..
10	87	87
15	87.5	..
20	89.5	87.3
25	89.5	87.8
30	90.8	86.8
40	91	88.2
50	90.5	88.3
60	90.75	87.2
75	91.3	84.7
100	92	92

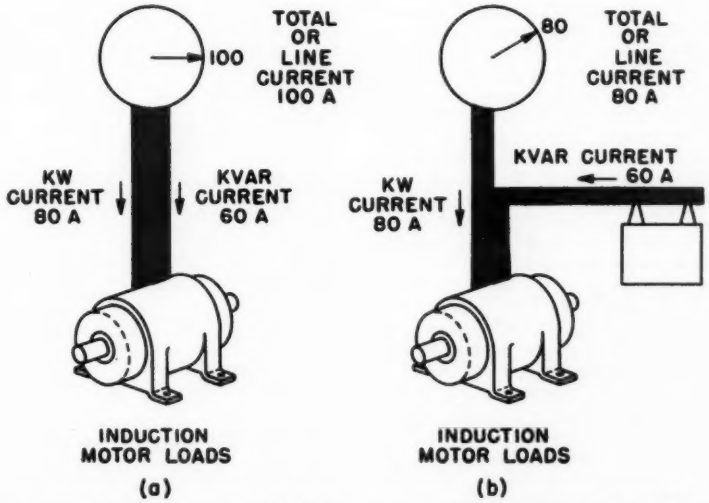
Efficiency comparison of 1800-rpm a-c and d-c motors

HOW TO IMPROVE POWER FACTOR

Since the power company charges for the current it is desirable to pay for only power-producing current, in which case the wattless current must be reduced. As in the glass of beer, it is also desirable from the customer's standpoint to receive all beer and no foam. If the kilowatt current does not change, as is usually the case for a given load condition, the power factor will improve if the kilovar current is reduced. When the kilovar current becomes zero, all of the current is kilowatt current and, therefore, power factor will become unity or 100 percent.

For example, if an induction motor draws 100 amperes from the line and if 80 amperes represents power-producing amperes, then 60 amperes will be required for magnetizing or wattless power. If a capacitor is installed to supply the kilovars, the line current will be reduced to 80 amperes and, as far as the power company is concerned, the system will have unity power factor.

One important fact to remember when power factor is to be improved: *The simple subtraction of kilowatts from total KVA never equals the kilovars except at unity power factor.*



Improving Power Factor. If an induction motor draws 100 amperes from the line, and if 80 amperes represents power-producing amperes, then 60 amperes will be required for magnetizing, or wattless, power (see a). If a capacitor is installed to supply the kilovars, the line current will be reduced to 80 amperes and, as far as the power company is concerned, the system will have unity power factor (see b)

Engineering and Designing A-C Machines

The mine locomotive is the only exception to the statement, "Any mining machine that can be built to operate on d-c also can be built to operate on a-c." The reason the mine locomotive is excluded is not because of motor and control characteristics but because a three phase trolley system is impractical for mine locomotives.

However, the engineer and designer must acknowledge certain a-c equipment characteristics:

VOLTAGE

Voltage at a-c motor *terminals* must be kept within plus or minus 10 percent of name plate value. Thus, a 440-volt motor should have more than 396 volts but less than 484 volts impressed on its *terminals.*

Of greatest concern is the effect that voltage has on torque. The torque available from an a-c motor varies in proportion to the square of the voltage applied to its terminals: 90 percent voltage will produce 81 percent torque, 80 percent voltage will produce 64 percent torque, etc. Starting torque is 200 percent and breakdown torque is 240 percent when name plate voltage is applied. However, if the voltage is 70 percent of rated (308 volts for a 440-volt motor), the starting torque is barely equal to the full load torque normally available at rated voltage. This means that more than 70 percent voltage must be impressed on the motor terminals if this motor is to start a load whose break-away, or starting, torque is equal to the running torque.

Trailing cable and on-the-machine cables must be large enough to prevent objectionable voltage drop, and consequent loss of torque, during starting if rated voltage is available at the nips. Also, it is highly important that inrush current data on large motors be made available to the

distribution system engineer so that he can provide cable and other equipment of adequate size for starting the largest motors without disrupting the power system.

It should be noted, also, that if the motor referred to above is operating at 70 percent of rated voltage and it encounters a momentary overload equivalent to 120 percent of rated torque, it will stall.

The effect of low voltage on control must also be considered on a-c machine designs. Standard a-c contactors are guaranteed to pull in at 85 percent of rated voltage and will drop out at 60-70 percent. Special contactors are available that are guaranteed to pull in at 80 percent and drop out below 60 percent. Actually, the voltage drop does not occur until after the contactor is closed so the drop out characteristics are the determinant in selecting contactors for single motor machines. However, dependable operation of multi-motored machines often requires the use of 80 percent pull in, 60 percent drop out contactors.

If voltage drops too low on any a-c contactor, the unit will chatter and hum and the contacts will burn. This may result in their becoming stuck in the closed position, making it impossible for the operator to stop the machine.

Effect of voltage variation on a-c motor characteristics

Condition	Power Factor	Torque	Speed	Full Load Efficiency
High Voltage	Decreased	Increased	Slight Increase	Slightly Higher
Low Voltage	Increased	Decreased	Slight Decrease	Slightly Lower

STARTING AND PLUGGING

Practically all a-c mining machines are equipped with squirrel cage motors that are started across the line by a simple across-the-line starter. In comparison, d-c motors above 10 hp require starting resistors and contactors. When a squirrel cage motor is started across the line, its inrush current may be more than 500 or 600 percent of full load current. This is in contrast to the starting current of a d-c motor which can be held to a value of little more than rated full load current—if careful selection is made of steps of starting and values of starting resistors. Ordinarily, d-c motors have inrush currents of about 250 to 300 percent of full load current.

Large inrush currents are objectionable because they create a voltage drop in the machine cable and supply system and generate heat in the motor. The effect of voltage drop and ways of guarding against it have been discussed. In a similar manner, a skillful designer can overcome the heat problem. The simplest solution is to be sure that the motor has the lowest inrush current consistent with proper operating characteristics. Usually this solution is adequate. If not, it may be necessary to use starting resistors, slip ring motors, or other more elaborate devices.

Plugging of any type of motor is objectionable. However, on some machines it is unavoidable and may even be necessary on a few. Problems resulting from plugging a motor are similar, in many respects, to those due to starting it, except the effects are more extreme. Ordinarily, the greatest problem is to minimize or dissipate the heat generated when the motor and machine are rapidly stopped and started in the reverse direction. The several means for doing this are so interlocked with the overall machine design that this report would become too long if they were discussed.

Ordinarily, a-c motors come up to speed faster than d-c motors because the latter are started with starting resistors. Such rapid starting may stretch belt conveyors or create shock loads in gear reducers, chain drives, etc. Usually it is possible to overcome these undesirable effects by carefully selecting the starting torque characteristics of the a-c motor. If this does not provide adequate relief, it may be necessary to use starting resistors (as is done on d-c motors), slip ring motors, fluid couplings, or similar devices.

Compared with d-c motors, a-c squirrel cage motors are far less susceptible to damage from overspeed and, in addition, have a natural facility for resisting speeds much in excess of synchronous speed by operating as an induction generator. Under this principle of operation, if an overhauling load is imposed on a squirrel cage motor while its leads are connected to the line, its speed will increase approximately as far above synchronous speed as it would operate below synchronous speed if it were driving the load instead of being driven by it. Thus, if a 10 hp, 1160 rpm motor has a 10 hp overhauling load imposed on it, it will rotate at approximately 1240 rpm as long as its leads are connected to the line and pump the power from the overhauling load into the lines.

RUGGED COMPONENTS

Except for the trailing cable, an a-c machine is simpler and more rugged than a d-c machine.

Single speed squirrel cage motors require three conductor cables, whereas most d-c motors require at least a three conductor cable and, in the case of a reversing compound wound motor, a five conductor cable.

The major advantage offered by an a-c machine is in the simpler, more rugged motor. A-C control is simpler than d-c, and contact tip life is estimated to be three times that secured from d-c contacts in similar service. The reasons for this are:

(1) A-C current arcs are inherently easier to interrupt than d-c arcs, as both current and voltage pass through zero twice each cycle.

(2) Overloads that a-c contactors are expected to interrupt are less than d-c overloads. The maximum overload that an a-c motor normally imposes on its control is the locked rotor condition which is about six times rated current. Severe overloads on d-c motors may result in currents well above six times normal.

(3) Fault capacities of the a-c and d-c systems are comparable. However, the a-c contactor is normally relayed to open only on thermal overloads and is not expected to interrupt short circuits which usually are interrupted by the circuit breakers backing up the a-c contactors. D-C contactors are often relayed with instantaneous relays and may attempt to interrupt fault currents.

LIGHTING

A-C has a great advantage over d-c because sturdy, trouble-free transformers can be used on a-c machines to reduce the voltage applied to lights. This permits the use of rugged, heavy filament bulbs which resist bumps and vibration encountered on mining machines during normal operation. Modern high speed mining has created the need for better illumination. Unfortunately, because of the explosion-proof design of mining machine headlights, an appreciable amount of time is required to change bulbs. These two conditions combine to favor the use of bulbs that will give the long life available from low voltage filaments.

SMALLER COMPONENTS

In general, a-c motors are lighter and smaller than equivalent d-c motors. A-C motors are about half the weight and half the size of d-c motors having equivalent speed and continuous horsepower. This means that more horsepower can be packed into the space available for motors. This size advantage can be enhanced by the use of silicone insulation at its full temperature of 180°C in a-c motors.

A comparison of a-c and d-c motor efficiencies compiled from data furnished by three leading manufacturers of mining machine motors shows that a-c has a slight advantage in this area.

Since the maximum torque available from an a-c motor usually is less than

Horsepower Size Range	Lb/Continuous HP		Cu In./ Continuous HP	
	A-C	D-C	A-C	D-C
0- 10	25	45	262	478
10- 25	24	50	225	605
25- 50	17	52	230	720
50-100	17	41	242	508
100 & Larger...	20	41	206	456

A-C motors are lighter and smaller than equivalent d-c motors as shown by the above comparison table for 1800-rpm a-c and d-c motors

that of a d-c motor, it is possible that mechanical components, such as gearing, drive shafts, etc., can be made smaller on a-c machines without reducing their dependability.

It is necessary to provide maximum accessibility to commutator and brushes on d-c motors. Valuable space often is required and sometimes the accessibility is not completely satisfactory. Such conditions do not exist on a-c machines using squirrel cage motors. About the only time an a-c motor needs attention is to be lubricated every three to six months. Thus, in addition to being smaller, an a-c motor may be placed in a more confined space.

The trend toward more powerful machines for use in thinner coal seams can be accelerated if the engineer and designer take full advantage of a-c.

MAINTENANCE

The reduced maintenance and greater dependability of a-c machines will show up in lower cost per ton.

It is true that trailing cables on a-c machines are more complicated due to the need for three power conductors instead of two. This disadvantage can be overcome by systematic and regular cable inspection and a firm rule to replace a trailing cable as soon as its dependability becomes suspicious. In other words, practice preventive maintenance.

The vast majority of d-c motor failures and maintenance requirements are associated with the armature, commutator, and brushes. These may be caused by:

(1) Oil or grease on commutator.
(2) Brushes worn to rivets and scoring commutator.
(3) Brushes sticking.
(4) Weak brush spring.
(5) High commutator bars.
(6) Flash-over.
(7) Overheating and throwing solder.
(8) Centrifugal force pushing out coils and wedges.
(9) Shorts and grounds caused by carbon dust from brushes.

The a-c squirrel cage motor eliminates all of these troubles. Mute proof of this is the absence of handholes and covers. The only attention it requires is occasional lubrication and it may be said safely that the time required to lubricate a squirrel cage motor a period of five years would be equivalent to the time required to change one set of brushes in a d-c motor—a maintenance procedure that is required at intervals ranging from once every six months to once every two years and which, when forgotten, results in the loss of a costly motor and an often greater loss in tonnage produced.

Any motor suffers damage if it is stalled for more than a few seconds. Subsequent operation of a d-c motor usually throws melted solder out of the commutator risers and an a-c motor usually develops an open rotor. The d-c motor that has been stalled may be operated until leads are thrown out of the commutator or until corrosion and burning between the commutator slots and coil leads raises the armature circuit resistance sufficiently to cause malfunction of the motor. The improper operation of an a-c motor with an opened rotor usually is apparent immediately. Thus, it may be seen that improper handling of a d-c motor may go undetected for many hours or days, whereas improper handling of an a-c motor usually is immediately apparent.

When a d-c motor operates improperly, the first thing a good maintenance man will do is to stop the machine, locate the trouble, and try to fix it. Quite often, these repairs, made hurriedly at the faces only delay ultimate failure for a short time and several such repairs may be made before the motor actually stops running. Often, valuable time is spent trying to locate and repair the trouble when the motor is damaged beyond repair. Under any circumstances, the $350 to $1000 charged against machine down time makes the working face area an exceedingly expensive maintenance shop.

In contrast to these ordinary d-c motor repair practices, when an a-c motor fails to operate, it usually is due to (1) low voltage at the motor terminals, (2) a ground in the stator, or (3) a short in the stator.

Voltage can be checked quickly with a voltmeter and a ground can be located easily with a suitable instrument so, if the motor still won't run, it undoubtedly is due to a short and the motor should be removed and replaced as quickly as possible because it is impractical to repair a shorted a-c motor at the face. Thus, a-c motor maintenance is simpler and less time-consuming than d-c and a maintenance man spends less time worrying about whether that last patch-up job will hold together until the next shift.

A-C motors produce less peak torque than similar d-c motors. This results in fewer broken and excessively worn mechanical parts which, in turn, reduces down time and maintenance costs.

One maintenance precaution must be closely observed on a-c control, however: when power is applied to the contactor (or linestarter) coil, the armature must close and seal or the coil will quickly burn out. It is poor practice, therefore, to block out the armature of an a-c contactor in order to check the control sequence of the machine. This can be done on a d-c machine because the current flowing in a d-c contactor coil is substantially the same when the contactor is open or when it is closed. On the other hand, the current flowing through an a-c contactor coil is quite a bit greater when the armature is open than when it is closed. This is because the coil resistance and the magnetic circuit actuated by it combine to form an impedance to the flow of alternating current. (Impedance is the a-c counterpart of resistance in d-c circuits. It is composed of resistance and a characteristic called reactance, which is determined by the magnetic circuit associated with the coil in question.) The impedance is considerably greater when the contactor is closed than when it is open. Therefore, more current flows through an a-c contactor coil when the armature is open than when it is closed.

The outstanding advantage to be derived from a-c machinery is less maintenance. One mine reports that one d-c machine has more motor trouble than ten similar a-c machines. Another mine does not need an electrician on an a-c machine section but is obliged to keep one on a d-c machine section. To achieve such results it is usually sufficient to observe three maintenance precautions: (1) Maintain voltage at motor terminals between plus and minus 10 percent of name plate rating, (2) lubricate adequately, and (3) don't stall the motors.

Bacterial Leaching of Manganese Ores

Preliminary investigations point to a promising new low-cost process for beneficiating low-grade manganese ores

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THE Bureau of Mines has studied many processes for beneficiating domestic manganese deposits. All the known large reserves of manganese in the United States are low in grade. This article describes preliminary studies at the Electrometallurgical Experiment Station, Boulder City, Nev., to develop a process for beneficiating these low-grade materials by leaching with microörganisms.

The action of microörganisms has been extensively studied in fields other than medicine, and a number of commercial applications are in use. Fermentation is an old art and more recently has been used in producing organic chemicals. Microöganisms are used in modern sewage plants. Geological studies have indicated that microörganisms are a factor in the formation of certain ore bodies, such as the bog-iron and manganese deposits. L. C. Bryner and others have studied the effect of microörganisms on the leaching of sulfide minerals, and the method is in use on the waste from the Bingham Canyon copper deposit in Utah.

In leaching copper ores the microörganism attacks the sulfide minerals to form sulfuric acid and soluble copper sulfate. In leaching manganese, without the presence of sulfide minerals, the microörganisms apparently act directly on the manganese mineral through a mechanism not as yet well defined.

Only Certain Cultures Effective

To test the basic idea of leaching manganese ores with microörganisms, a simple experiment was performed. 500 gm of an ore containing four percent manganese as the oxide and one liter of tap water were placed in a two-liter bottle. A small quantity of material (leaves, yeast, manure, soil, etc.) containing a wide variety of microörganisms was added to the bottle. It was assumed that the organisms suited to the environment would thrive as compared with other species. A duplicate, without inoculation but otherwise subject to the same conditions as the first, served as the control. At the end of 90 days, the solution in the inoculated bottle contained five grams per liter manganese, the control nil.

Samples were taken of soil, stagnant water, moist ore piles, and tailing dumps. From these samples 15 different cultures of microörganisms were isolated by making transfers from separated colonies in petridish cultures. These 15 cultures were then tested for their ability to leach manganese ore in a manner similar to the first experiment, except that bacterial aseptic laboratory techniques were used. Only four of these cultures proved capable of leaching manganese from ores; the others were discarded. It should be noted that for a particular species to perform as a leaching

agent it may be necessary to obtain a strain or sub-species that has been conditioned to a manganese environment. Several years of conditioning may be necessary. The four cultures that leached manganese came from such an environment.

Tests Conducted to Determine Percent Extraction

Using these four cultures approximately 25 leaching tests were made on various low-grade manganese ores. All of these tests were positive, in that some manganese was leached. The highest concentration of manganese obtained in solution was seven gm/1, the average was two to three gm/1. These tests qualitatively demonstrated that manganese could be leached with microörganisms. Four leaching experiments were then made to investigate the percentage extraction of manganese from some prospective low-grade ores representing substantial reserves.

For this purpose, four samples were obtained; one from the Boulder City, Nev., deposit and three from the Cuyuna Range.

The large, low-grade, sedimentary Boulder City deposit's manganese content averages three percent.

The Cuyuna samples represented a much larger tonnage occurring as three different types of manganiferous material—"black ore," "brown ore," and "carbonate slate"—averaging five percent manganese. Because the Cuyuna types grade into each other, a process that does not require selective mining would be advantageous.

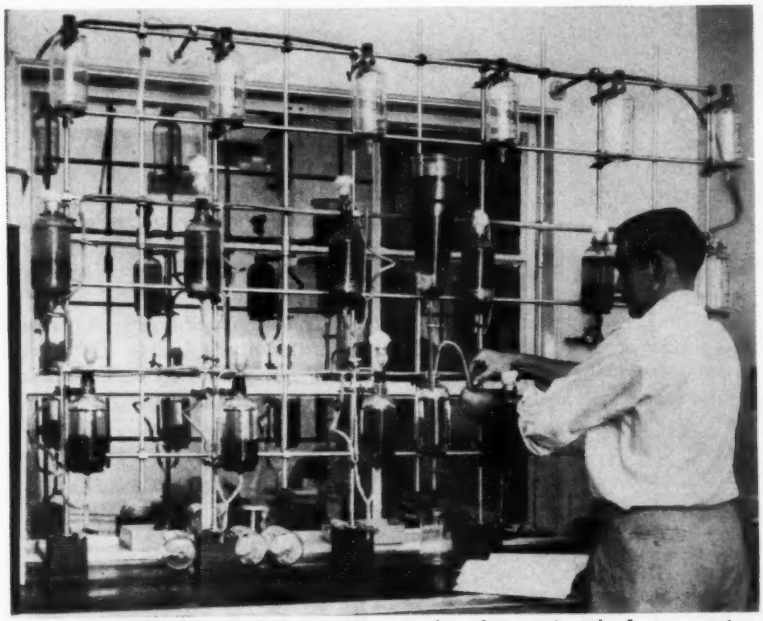
For these four tests to investigate the percentage extraction of manganese the following procedure was used. 100 gm of each ore was leached with 1000 ml of water that had been inoculated with the four cultures of microörganisms. Eight gm of a nutrient (a beef and peptone extract) was added at the start to promote growth. During the tests clear solution was decanted from the leaches periodically to maintain the solution strength below three gm/1 manganese, and a nutrient solution (sterile water solution containing 0.8 percent beef extract and peptone) was added to keep a constant volume. The pH was controlled at five to six by adding a trace of glacial acetic acid. The tests were made at room temperature ranging from 70° to 85° F. In 60 days an average of 97.5 percent of the manganese was extracted from these four samples. The controls, which were sterile duplicates, extracted only a trace of manganese.

The manganese in the solution withdrawn from the leaching tests was precipitated by raising the pH to above 7.0 either by adding small amounts of bases or by allowing the organisms to continue activity which raised the pH and precipitated the manganese. Approximately 24 hrs without pH control would cause precipitation of the manganese to begin. The iron in these ores was also leached by the organism used for these tests. It is possible that a selective organism could be isolated to leach only manganese or that selective precipitation of manganese and iron could be used for their separation from solution.

The precipitate from the Cuyuna solutions contained 39.0 percent manganese, 12.4 percent iron and 16.2 percent total carbon; from the Boulder City solution, 33.8 percent manganese, 2.5 percent iron and 19.7 percent total carbon.

Further Research Under Way

The conclusions to be drawn from this preliminary study are that manganese can be leached from low-grade ores with the aid of microörganisms. Whether or not a process may be developed from this information depends on future research. Emphasis at present is on determining the actual mechanism of leaching, the soluble compound or compounds of manganese, and the changes in composition necessary for precipitation. This study should also yield data on the effects of some of the variables, such as time, temperature, nutrient composition and concentration, hydrogen-ion concentration, conditioning of microörganisms, activity levels, etc. Another necessary phase of the research program is amenability tests of low-grade domestic manganese ores. The present study was limited to oxide and carbonate ores, but future work will include the silicate ores (rhodonite) and slags containing manganese.



In one group of tests, several 100-gm samples of approximately four percent manganese ore were leached with 1000 ml of water that had been inoculated with certain cultures of microorganisms. The result—an average of 97.5 percent recovery

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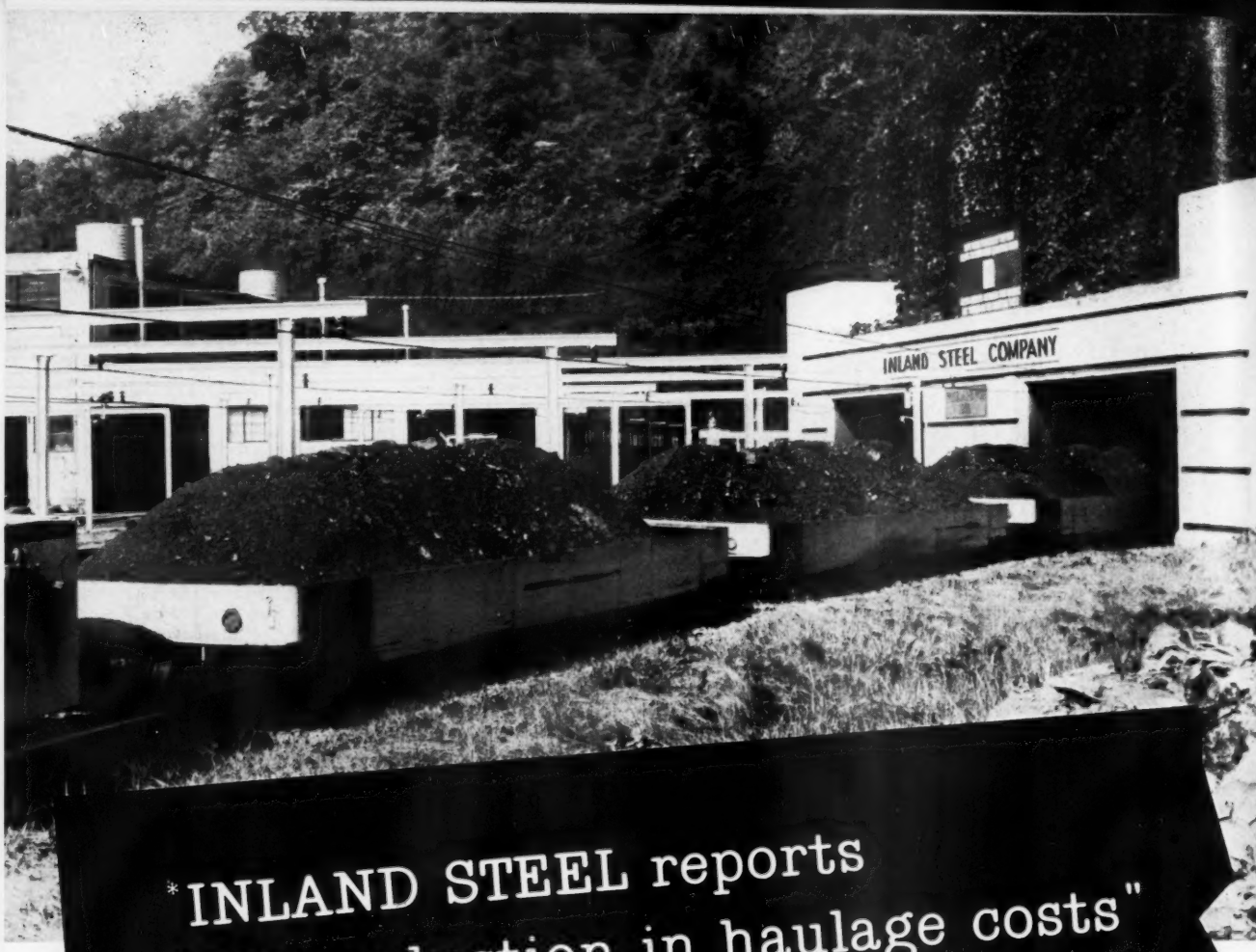

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**Complete report on Inland's findings elsewhere in this issue.*

MINE CAR REPLACEMENT

at

WHEELWRIGHT and PRICE NO. 1 MINES

Mine life . . . amount of old workings . . . distances . . . tonnages . . . speed and size of trips . . . weighing and dumping facilities . . . power requirements . . . basic mining plans . . . size and design of cars . . . capital investment required . . . anticipated realization from making the change . . . all of these factors were closely examined by management before approving replacement of 1500 small cars with 505 larger units at two Inland Steel Co. coal mines

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and
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WHEN Inland Steel Co. commenced operations in the Elkhorn No. 3 Seam at its Wheelwright, Ky., properties in 1930, a wood and steel car was inherited from another company. In 1931 management selected as a replacement a 4-wheel, 24-in. high, 90-cu ft capacity steel mine car with link and pin coupling for its then hand-loading operation. With the advent of mobile machinery, rail haulage was retained as the most practical solution for long haulage distances. As a result, these cars were

Larger cars and related facilities have paid off with a 33 percent reduction in haulage costs

slightly altered and supplemented until by 1948 there were 1500 on hand.

Although shuttle cars were introduced in 1946, coal was principally loaded directly into mine cars by mechanical loaders until 1953. The design and size of these mine cars permitted full loading from the mechanical loaders, and a larger car would have presented a loading problem with this system. With the development of machinery to perform in lowered seam areas, loading into mine cars became very expensive and impractical. Also, the load realization for the cars from these areas was reduced, thus imposing limitations on other mining efficiencies. The conversion to a shuttle car operation with track loops confirmed the anticipated need for having a larger and more flexible mine car with this system.

262-Cu Ft Capacity Car Selected

Mine haulage and cost factors were examined and evaluated for the old car versus a new, larger car with a Price Mine No. 2 application in mind. This mine was selected because it was new, small and it had a low seam height average of 34 in. The primary question in selecting a larger car was whether its vertical dimension should be determined by the natural seam height or whether roof and bottom should be removed to permit passage of the car. The width dimension obviously was controlled by development entry widths, which in turn were determined from experience with roof and floor conditions. The length dimension was determined by its practical integration into the company's mining plans with the equipment on hand. After consideration of the possibilities, it was decided the dimensions of the car should conform to the limits of the natural seam height, should conform to widths of present haulways and should be as long as possible to serve equipment on hand.

An 8-wheel, 24-in. high, 262-cu ft capacity car with automatic couplers was selected and 70 cars were placed in use at this mine in March 1954. Improvements in haulage, coordination with face activities and safety were immediately apparent and the car sold itself at this location.

Haulage Involves Distances Up to 12 Miles

After an allowed time for experience, management determined that the operational performance of the cars fulfilled and even exceeded prior expectations. This factor—along with such considerations as 660 of the old cars at Wheelwright and Price No. 1 mines being older than 20 years, other cars approaching this age and rising maintenance costs in general—hastened management's decision to make a study evaluation for replacing the entire 1500 old cars with larger and more efficiently designed units.

Seam height at the Wheelwright and Price No. 1 mines is 42 in., with a minimum of 30 in., and tonnages for these mines currently average 7750 for raw coal and rock and 5850 for clean coal. Haulage involves distances to 12 miles, one way, from the head house with the average being about 7.5 miles. Main line haulage is on 60- and 80-lb steel rails on treated ties, with limestone ballast. Secondary haulage is on 30-lb steel rails on steel ties. Grades are generally in favor of loaded trips and are not commonly excessive due to practiced attention to grading work. Locomotive sizes are chiefly 6 tons for secondary and 15 tons for primary haulage.

The following factors were closely examined: Life of mines, amount of old workings, distances, tonnages, speed and size of trips, weighing and dumping facilities, power requirements, basic mining plans, size and design of cars, capital investment required and anticipated realizations from making the change.

Major items of cost that received close scrutiny were: New car investment, head house conversion, automatic couplers for locomotives, installing new, larger radius turnouts and making additional clearances.

The major benefits for acquiring a larger and more flexible mine car were thought to be: added safety, greater pay loads per trip, reduced track cleaning, reduced car maintenance, fewer wrecks, faster haulage, more rapid couplings, reduced lubrication costs and less car change time on production sections.

505 Large Cars Replace 1500 Small Units

Preliminary work of the committee indicated the adoption of new mine cars would be advantageous so work began to select a specific car as a basis for further study. A higher car than the one in use at Price Mine No. 2 was considered for the higher coal seam, but it was resolved that it again would be better to widen haulways than to remove roof or bottom. The same 8-wheel, 24-in. high, 262-cu ft capacity car with automatic couplers was selected for possible use at the Wheelwright and Price No. 1 mines. This car received much initial consideration because of its favorable performance at Price No. 2 Mine, because its vertical dimension does not exceed the natural seam height in nearly all areas and because it would be interchangeable with the cars at Price No. 2 Mine. Upon completion of this phase of study in May 1955, the committee recommended replacement of the 1500 small cars with 505 of these larger cars. Management approved, and an appropriation was established for the project.

Smooth Transition Result of Adequate Planning

Then preparation work was begun in earnest so a smooth transition from the old to the new could be made during the miners' vacation of 1957. New projection standards were devised; new entries were driven accordingly; larger radius turnouts were installed; additional clearances were made; much haulway retimbering, bolting and installing channel iron strips were done; automatic couplers, with adapters for link and pin couplers, were installed on locomotives; pole bases were moved on locomotives, and some trolley wire was repositioned.

Delivery of the new cars began in March 1957, and was completed in July 1957. The cars were stored in idle empty regions underground. At miners' vacation time, most of the preparation work was behind and materials and planning had been staged for conversion of the head house. Clearance and haulage details were checked beforehand by hauling a larger car throughout the mines.

On June 26, a few of the large cars were loaded on the second shift production sections and were used on all sections June 27. This was planned so the old cars could be emptied before the rotary dump was converted,

A COMPARISON OF OLD AND NEW CARS

	New Cars	Old Cars
Track Gauge	42"	42"
Length, Coupler Centers	26'-4"	13'-8½"
Length of Body	24'-6"	12'
Width, Inside of Car	7'-11¼"	6'
Height, Loaded	23"	24"
Height, Empty	24"	24"
Capacity	262 cu ft	90 cu ft
Minimum Turning Radius	53'	25'
Weight	8,350 lb	3,665 lb
Type of Coupling	Automatic	Link and Pin
Rail Clearance—Loaded	3½"	3¾"
Rail Clearance—Empty	4½"	3¾"
No. of Wheels	8	4
Wheel Diam., tread	10¼"	14"
Wheel Diam., flange	12½"	16⅜"
Truck and wheel centers, resp.	21'-6"	42"
Wheel Bearings	Timken Roller	Timken Roller
Body Structure	Welded	Riveted and Bolted
Live to dead load ratio	2.30	1.58
Cost/Cu Ft Capacity	$6.40	$8.89
Cost/Ton Coal Capacity	$178.40	$275.86

Main line haulage is on 60 and 80-lb steel rails on treated ties, with limestone ballast. Secondary haulage is on 30-lb steel rails on steel ties

Uneven roof over haulageway is supported with roof bolts, channels, and piers and sprayed with roof coating compound

and so that management might gain some indication of the adequacy of underground preparation. Although the miners' contractual vacation period covered the June 28-July 8 dates, inclusive, the company suspended operations for three weeks from June 28 to allow for completion of conversion of head house and installation of coal recovery equipment in the screen house. The installation of new car dumper, new scales and new car feeder was completed on schedule and production work resumed July 19.

4.1 Less Trips Per Day Yield Same Tonnage

The acquisition of the new cars increased haulage capacity (pay load per car increased from 2.9 to 9.6 tons) as shown:

Old Cars

Weight of 60 cars (3665 lb each)	219,900 lb
Weight of material (5800 lb per car)	348,000 lb
	567,900 lb
	or 284 tons

New Cars

Weight of 20 cars (8350 lb each)	167,000 lb
Weight of material (19,200 lb per car)	384,000 lb
	551,000 lb
	or 275½ tons

There is slightly less total weight in a trip of new cars, as shown. However, the pay load for main line trips has been increased 36,000 lbs, or 18 tons. This represents about a ten percent increase. With a total output of 7750 tons of material per day, the number of main line trips required to handle this tonnage is shown for both old and new cars:

$$\text{Number of trips, old cars} \quad \frac{7750}{174} = 44.5$$

$$\text{Number of trips, new cars} \quad \frac{7750}{192} = 40.4$$

The difference amounts to 4.1 trips per day.

Other Benefits Include Less Maintenance

A sufficient number of the new cars were purchased to insure an increase in storage capacity as compared to the old cars, hence the company has experienced more efficient distribution of empties and collection of loads.

The prior practice of staging trips on the off-shift was no longer needed with the new cars and was eliminated. This was made possible because more production work has been realized from the haulage crews on the production shifts, which has been enhanced by having more storage capacity on hand.

The new electronic scales for the new cars was designed so that the weighing of coal could be coordinated with the activities of the car dumper, and this man currently weighs, records weights and dumps the material.

The design of the inside surfaces of the old cars permitted clinging or bridging of coal and refuse material to the cars. Removal of this material required a substantial portion of a day's work for a man on each shift at the head house. This problem has been all but eliminated with the new cars.

In addition to less maintenance being required due to being new, it seemed logical that less maintenance would be required because of improved roadability, fewer wrecks, a lesser number of cars and improved design of cars. To date, that is the company's experience. There has been a reduction in maintenance.

Trucks on the new cars are spring mounted. There is little side sway due to having longer track centers and automatic couplers have eliminated the bumping and jerking experienced wih the old cars. The net result has been less spillage on haulways to the extent that 650 less man-shifts of track cleaning work were required in a seven-month period.

The practice with the old cars was to rock dust the haulways after each track cleaning work phase. With the new cars, there has been less track cleaning and because of less vibration, there has been less dust in suspension to settle on rock-dusted surfaces. Therefore, 200 tons less rock dust and 90 less man-shifts have been required over a seven-month period.

Advantages vs. Limitations

The following items have proved beneficial to the operation:

1) Haulage is safer because of safer roadways and safer cars.

2) Car change time, while shuttle car waits, has been reduced on production sections.

3) Trip speeds are faster.

4) Fewer wrecks have resulted in less damage to cars and less spillage on haulways.

5) Lubrication costs, labor cost especially, are less.

6) Automatic couplers have resulted in more efficient handling of trips and have minimized exposure of the brakeman.

7) Sharp jerks have been eliminated, thus preserving the life of the cars.

8) Reduced shock and strain on track have resulted in a reduction in track maintenance.

9) Car dumper handles about 30 percent of the number of cars as formerly, resulting in less wear on dumper and less power consumption in this activity. Also, the company has more dumping capacity, chiefly due to having a faster automatic car feeder and an increased amount of material dumped per car.

10) Less inventory parts are required because of fewer cars.

11) The starting and rolling friction factors are lessened with the new cars, thus requiring less operating power.

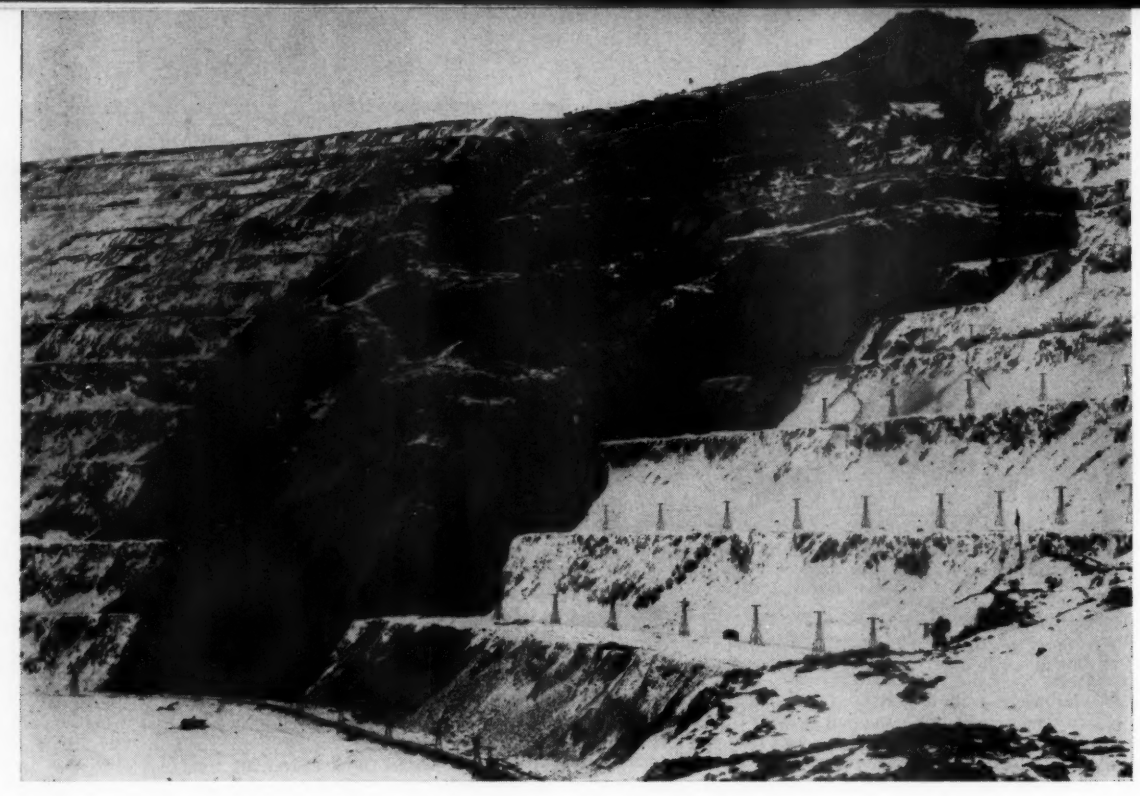
12) For the future, less track space will be required for the storage of trips.

Management has found the following items to be more critical with the new cars:

1) It is more serious to have cars partially loaded because it effects a greater reduction in the total haulage or car capacity system with the large car than it does with the small car.

2) Less weight per trip is handled with the large cars. However, decreased rolling friction, lack of slack in couplers and lack of side sway have increased the braking problem. A different type shoe

(Continued on page 84)



SLOPE STABILITY IN OPEN PIT MINES

By W. A. VINE
Head, Department of Mining and Engineering, Montana School of Mines

Only through continued study can we get closer to our objective of being able to control the forces causing slope failure

THIS paper is for the purpose of collecting certain facts and developments that can be used to predict instability of open pit walls and some suggestions for the avoidance of difficulty in certain situations of incipient failure. No pretense is made for originality because the fundamental work of Terzaghi and others in the soil-mechanics field has been drawn upon heavily for the background material; the purpose herein is to collect the material and point it up to the solution of the particular problems to be found at open pit mines.

Interest in this subject has been stimulated after numerous instances of disasterous failures of particular open pit walls that have resulted in loss of life as well as loss of considerable ore and money. The problem is looked upon much like the meteorologist looks upon his study of the manner of control of the great destructive power of storms; we still do not have all the answers but the degree of control is proportional to the knowledge that we have and, therefore, by continued study we get closer to our objective of being able to predict and control the forces which go to make the destructive slides and other manifestation of failure of the walls of open pits. This short discussion includes the results of the author's recent investigation into literature for some clues that may be used for our purpose, and some of his interpretations of those clues.

Materials Comprising Pit Walls Vary Between Three Limits

It is advantageous to investigate the properties of the material making up the walls of an open pit, and define the limits between which will be found all physical conditions of the material. It is found that the system is three-cornered; at one apex is the condition of a solid, at the second apex is the condition of a liquid and at the third apex is the condition of an aggregate of dry, loose, solid particles which have no bond or attraction between them. Each of these apices may be called an ideal condition, for which certain physical laws have been proposed and stated mathematically.

The solid condition is that in which stress in tension and shear may be resisted by an intermolecular bond. In the liquid, the intermolecular bond is still evident, but the individual particles making up the liquid can resist no shear because they are free to move in relation to each other, limited only to the time-rate of movement or viscosity. The third ideal condition is that of discrete solid particles offering no resistance to stress in tension, but whose surfaces possess the quality of having friction, so that there is resistance to shear within certain limits.

Anyone who has observed the material making up the walls of an open pit could catalog the condition as he observes it somewhere between the three ideal conditions. The author believes that the material exhibits most of the properties of the third condition; i.e., the condition of solid, loose particles, but with modifications. The discussion, therefore, will be directed from that angle, starting with the ideal conditions, and adding modifications as they appear. Another reason for starting with the loose, granular material is that the other ideal conditions allow for little or no compromise. In considering solids we must agree with the elasticians, that certain ideal conditions of elasticity and homogeneity exist, and that there is no easy way to take care of departures from the ideal conditions. Presently, advances are approaching the solution by assuming the condition of plasticity (that condition somewhere between the solid and the liquid), but the theory is as yet too complicated for everyday use.

Type of Material Determines Manner of Failure

The stress condition of the elastic solid need not concern us here, other than to provide some intuitive concepts of deformation and failure of solids which may help in visualizing the mechanics of failure such as occur under the conditions of stress encountered in the massive structure of the open pit.

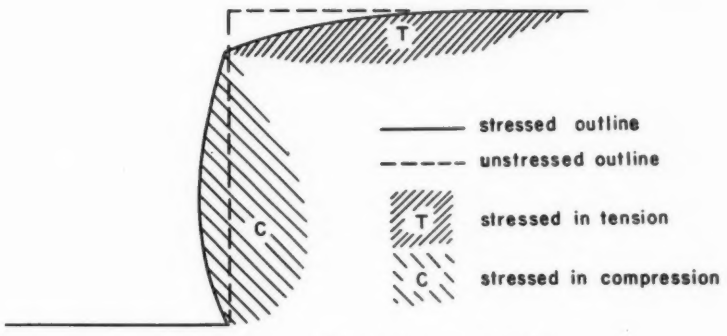


Fig. 1. Stress condition within a vertical bank

If a vertical excavation is made in an elastic solid, it is conceivable that the material near the toe of the bank is in compression and the material at the horizontal surface and removed some distance from the brow of the cut is in tension. (See Figure 1.) Any solid has limits to its strength in shear and tension, hence there is a condition when a solid, bounded by one vertical face, will fail because of its own weight when the height of the vertical face reaches what is referred to as the critical height. Signs of such a type of failure are a bulging of the material just above the toe of the bank and open tension cracks at the top surface at some distance from the brow.

On the other hand, in making excavations in loose, dry aggregates of solids there must be taken into consideration the angle of repose of the material, a phenomenon which is associated with dry sand. Dry, loose material will show no evidence f failure such as has been just described, but will continually and progressively fail by adjustment of the surface particles when a slope steeper than the angle of repose is attempted.

Failure of pit slopes can be observed to take place by both the foregoing processes, (1) sliding failure along deep shear planes, forewarned by open tension cracks at the surface outside the pit perimeter and swelling of the ground near the toe of the excavation; and (2), by surface adjustments of loose particles rolling down the face until a stable slope of rubble is achieved.

Relations Can Be Expressed Mathematically

The condition of stress in a dry, cohesionless aggregate of loose particles was stated late in the 18th century by the French mathematician, Coulomb. He related the unit shearing resistance of the mass of loose particles at the point of failure, t_f, to the frictional resistance of a certain unit cross-sectional area of the material, **p tan a**, by the formula,

$$t_f = p \tan a,$$

where **p** is the normal compressive stress and **a** is the angle of internal friction upon which the normal stress acts. For the condition where $p = 0$, that is at the surface of the pile of loose material, **tan a** is equal to the tangent of the angle of repose of the loose material.

A strong argument for using an approach to our problem from the angle of the loose aggregate of solids is that the stability equation may be modified to take care of the case where some cohesion exists between individual particles and, depending upon the amount of cohesion, approaching the condition of a solid. The provision for accounting for cohesion in Coulomb's equation is to add a term **c**, to the right-hand side, or,

$$t_f = c + p \tan a.$$

The units of the equation are as one would expect when talking about stress and unit strength; t_f is a shear stress or strength, **c** is a cohesive strength, **p** is a normal compressive stress (all in psi), and **tan a** is a pure number.

Pit wall failure is always failure by shear, that is, sliding of some material along either one surface or multiple surfaces. When failure is slow and is along multiple surfaces, it is called "creep," but when it is along one continuous, curved surface, and the time interval is short, it is a slide.

The statement can now be made that failure of a slope will take place if the conditions are such that the right-hand side of Coulomb's equation is numerically lessened relative to the left-hand side by some process that affects the material making up the slope; or, as a corollary, the bank will be stable if at all points within the bank, the right-hand side of the equation is numerically greater than the left-hand side.

Mining Operations Alter Values In Equations

It remains to investigate how mining operations succeed in altering the elements of Coulomb's equation to change the values of either side. There are four possibilities as the consequence of mining—two of which may tend to decrease the stability of the ground surrounding the operation, two of which may increase that stability. Mining operations at the bottom of an open pit may increase the shearing stresses in the mass of the material within the walls of the pit, but at the same time, may increase the cohesion of particles making up the mass, thereby effecting no change in the inherent stability of the walls; or the same mining may produce a change in the moisture conditions within the wall, thereby destroying some of the intergranular bond. Finally, mining at the rim of an open pit will reduce the over-all slope, thereby decreasing the shearing stresses within the wall mass.

The first part of our investigation has to do with failure conditions, and that part will be divided into two sub-sections, failure through increased shearing stress or failure through reduced resistance to shearing stress. As an example of the increase of shearing stress in the walls, we must point to the consequence of the mining operation itself. If it takes place as it does normally, in the direction of either deepening the pit on the same predetermined slope, or of increasing the diameter of the bottom of the pit without a corresponding increase in diameter of the walls all the way to the top, shearing stresses in the walls may be increased.

Pit Slide Mechanics Explained

Slides in pits have been observed to occur in the manner of the figure 2, along a curved surface starting near the toe of the bank and extending upwards so that when the sliding surface cuts the normal earth surface beyond the pit perimeter, the surface of the break is nearly vertical. This may be due to the fact that the material making up the pit wall has some cohesion and the first manifest failure is the development of tension cracks at the surface, which are vertical. As the tension cracks lengthen, one of them intersects the potential sliding surface.

Investigators of landslides imagine a circle of which the sliding surface of the mass involved is an arc. The center of the circle, or arc, is called the center of the critical circle, and the mechanics of the situation involve moments about this center. The moment inducing the mass to slide is the weight of the material,

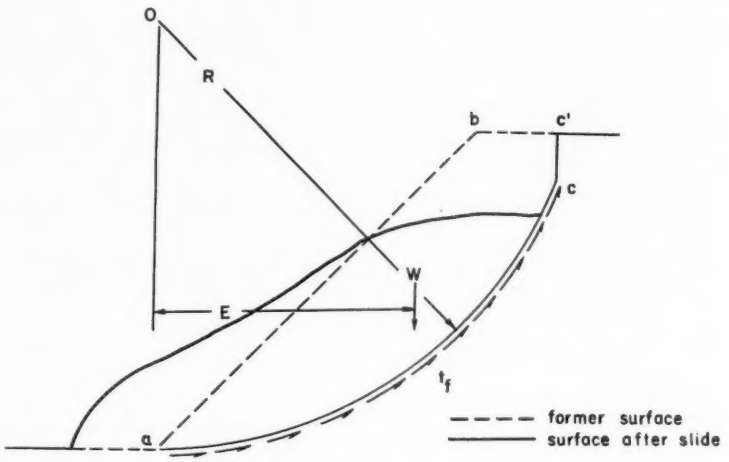


Fig. 2. Mechanics of a slide

W, within the sliding surface multiplied by the moment arm, **E**. The moment resisting the slide is the total shear strength along the surface of sliding, t_f, multiplied by length of arc **ac**, multiplied by the moment of the resistance, **R**, or radius of the circle.

Thus, when the system is just in balance,

$$EW = (t_f)(ac)(R).$$

Sliding will occur when the driving force **EW**, is greater than the resisting moment. Steepening of the over-all slope changes the position of the center of the critical circle, and decreases the amount of the area resisting sliding. At the same time, it changes the position of the critical circle to include a greater weight of material within the critical zone or a mass whose center of gravity is at a greater horizontal distance from the center of rotation. The over-all effect of the consequences of steepening is to reduce the difference between resisting force and driving force.

The influence of earthquakes or the vibrations of blasting cause transitory changes in stress which may work two ways. The shear wave may momentarily increase shearing stress above that necessary to produce sliding, while the push-pull or longitudinal wave could momentarily decrease the normal compressive stress along the plane of sliding, either of which changes can be the trigger that sets off the movement along the surface of sliding.

Failure may also be instigated by any on of three processes involving the right-hand side of the foregoing equation: a) cohesion may be reduced, b) normal compressive stress may be reduced, and c) the frictional constant of the material making up the wall may be reduced.

Creep, Saturation, Ice and Drying Reduce Cohesion

The cohesion of the mass may be reduced in several ways, one of which may be through creep of the material; as slow deformation takes place, small sliding surfaces develop into bigger ones. The effect of water is quite important and it can be manifest in many ways. First, and probably the most important effect of water is to displace the air in voids which are already partially filled with water. Everyone is quite familiar with the cohesiveness of moist loose material, especially if it contains some clay, and the sudden change of consistency when more water is added and the air in the voids is displaced. Water may also decrease cohesiveness by dissolving the intergranular bonding material and, when water feezes, the expansion of the ice widens the already existing cracks and produces new ones, which in effect, destroys the over-all cohesiveness of the material. On the other hand, a prolonged dry spell or lowering of the water table causes loss of cohesion through loss of moisture, and during drying a clayey material sometimes shrinks and cracks, thus producing a less cohesive mass.

Frictional resistance may be lessened through the action of water by increasing the pore-water pressure. Water has the property of transmitting pressure equally in all directions, therefore the hydrostatic head of water in the pores of the granular material effectively reduces the compressive forces produced by the weight of the overlying material, thus decreasing frictional resistance along planes of sliding by an amount equal to the pore-water pressure head.

Finally, one cannot neglect the effect of moving water where such movement erodes the underground water courses, thereby reducing the area of contact of material that remains.

Deep Pits of the Future May be Cup-Shaped

After having mentioned some of the reasons for instability of the open pit walls, one might speculate as to some of the corrective measures that are suggested merely by the reversing of the process which produces instability.

The most obvious of the processes to restore stability is to lessen the slope angle or the depth of the pit and, in extreme cases, this has been done, either by excavating waste at the pit perimeter to lessen the weight of the moving mass, or back-filling at the toe to add frictional resistance to sliding. However, pre-planning to prevent slides is much more economical than corrective measures to restrain impending slides, so that the conclusion reached from the study of the shape of sliding surfaces and the mechanics of sliding cannot be ignored. *This conclusion is that the proper shape of a pit wall, when the material making up the wall has fairly consistent strength properties, is not a plane surface, but should be curved to somewhat follow the shape of an incipient surface of siding.* If this implication can be proved to have merit, deep pits of the future will be cup-shaped rather than the shape they are today.

In dealing with water, the obvious corrective measure is to provide the most desirable moisture condition by which the cohesive effect of capillary water is retained but the undesirable effects of saturation and high pore-water pressure are reduced. This may call for artificial means of regulating the water content of the material within the pit wall by diverting surface water from the area near the pit or sealing the surface in the perimeter area. Discovering and sealing off connections with distant water-bearing strata may be an almost impossible job; in that case, drainage of the dangerous area could possibly solve the problem. Drainage is sometimes accomplished through wells about the periphery of the pit, and "weep holes" in the pit wall itself.

Cohesion and greater frictional resistance to sliding could conceivably be artificially provided by pumping grout or other chemical solidifier into the region of the incipient sliding surface, or inserting solid objects in the same region. In that respect, if the author may be forgiven a flight into fancy, the person who is mechanically minded can run wild thinking up schemes of pinning, stitching, or rock-bolting on a massive scale which may, at some future time or under some unusual conditions, be economical.

Can coal regain some of the market lost to diesel fuel? Experiments conducted by a western railroad indicate that this possibility cannot be ruled out

By RAY McBRIAN
Director of Research
Denver & Rio Grande Western Railroad Co.

Nuclear Irradiation of Coal for Use With Diesel Fuel

THE Denver & Rio Grande Western Railroad Co. has always been interested in the use of coal as a source of power, principally because the firm operates in a coal territory and coal is one of the largest commodities which it hauls. During the year 1957 this railroad transported 6,800,000 tons of coal, out of a grand total of approximately 21,000,000 tons of commodities.

As early as 1943, during which time D & R G W as a railroad was a member of Bituminous Coal Research Council, the company had hoped it would be possible to design some type of coal burning motive power unit. During the early war years when it looked like it would not be possible to secure satisfactory diesel fuel, the railroad reviewed a Piscara gas producing unit and suggested it might be possible to gasify coal en route and thus be able to pipe direct to diesel locomotive gas which had the same properties. This idea was not deemed feasible by those then interested in such research projects, and it was not possible for the company to continue with the idea.

Then came the advent of atomic energy and all its implications. This discussion might aptly be termed "Coal and the Atom," but actually the scope is much larger. The suggested use by the railroad may be far outweighed by a potential application of the idea in other power fields. D & R G W became interested in all phases of atomic energy and found that there were possiblities of developments through irradiation by which it might be possible to improve or to secure fuels which would be of a lower cost than would be the use of nuclear fuel itself. The firm's application of all atomic energy so far as power is concerned is based strictly upon the question of economics, wishing, of course, to secure the lowest possible cost for its power.

Effect of Radiation Upon Coal

Rio Grande's Research Department, in one of its reviews of the effects of radiation, read a paper by Dr. Irving A. Breger, then of the Departmen of Geology at M.I.T., on the subject of "Transformation of Organic Substances by Alpha Particles and Deuterons." Upon subsequently visiting Dr. Breger, who is now with the Department of the Interior, U. S. Geological Survey, the research staff found that the Department of Interior was, in effect, radiating lignite coal and upgrading it into a similar bituminous type fuel. Such a paper was presented by Dr. Breger in 1956 at the National Colloid Symposium.

Last June Dr. Breger presented an oral paper before the Gordon Research Conference on Coal and

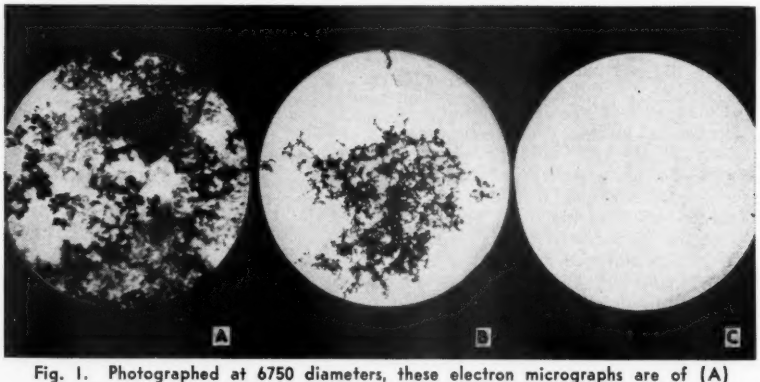


Fig. 1. Photographed at 6750 diameters, these electron micrographs are of (A) diesel fuel as received, (B) gasoline as received and (C) a typical well dispersed fuel after treatment with dispersant

Fig. 2. Coal ground to 250 mesh

said, "In summary, exposure of the coal specimens to integrated fluxes of slightly over $2X10^{19}$ slow neutrons/cm^2, led to noticeable changes in carbon content of the samples. The higher-rank coals, such as anthracite and low-volatile bituminous coal, lost carbon gradually during exposure; lignite and sub-bituminous coal lost carbon during early stages of irradiation and then the composition of the products showed increases in carbon content. Most changes were of the order of about two percent carbon. In the case of humic acid a linear increase in carbon was noted, this increase amounting to some seven percent. Similar data have been accumulated relating irradiation with fixed carbon, volatile content, oxygen content, and Btu values. The data have also been evaluated in an attempt to determine the radiochemical mechanisms responsible for the changes observed. In general, demethanation and decarboxylation appear to be the most likely mechanisms, but losses of methane and carbon dioxide do not necessarily occur simultaneously."

D & R G W Conducts Experiments

After visiting Dr. Breger the research department decided to investigate the effect of radiation upon coals in its own territory. The decision was based upon the department's use of the electron microscope in evaluating the petroleum types of fuel, which it found to be colloidal in nature, and remembering that Rudolph Diesel himself had intended the diesel to burn coal but was never able to secure proper particle sizes. Coals to be investigated were high volatile with a typical analysis of 12,500 to 13,500 Btu per lb, 38 percent volatile, 50 percent fixed carbon, 8.9 percent ash, 0.8 percent sulfur. The coal was ground to 250 mesh, placed in tin cans, sealed, and then exposed to various types of radiation.

The firm's coal irradiation studies were made at Brookhaven National Laboratories with coal alone and coal-oil mixtures. The total radiation in roentgens varied from 1,800,000 to 24,000,000. The time of exposure to radiation varied from minutes, a few hours, 24 hours or 1 day time. The radiation intensities varied from 250,000 to 1,000,000 roentgens per hour. All fuels were then evaluated by use of the electron microscope techniques.

It should be understood that all of the railroad's work is yet in the experimental stage. The research department is still experimenting with various dosages, the geometry of fuel, the storage type of radiation and of catalysts, and coal combustions. In its studies the department had the experience of running a small diesel engine (Witte, five hp) using irradiated coal in a No. 1 distillate. This engine ran for approximately ½ hour satisfactorily combustionwise. The output was comparable to that obtained with regular diesel fuel. One item noted, however, was the tendency of the cooling water temperatures to rise slightly during the burning of the coal and oil mixture. Particle sizes were determined using the electron microscope; the department is continuing its experiments in this field of study.

Figures Illustrate Work

The electron micrographs accompanying this article are illustrative of what the railroad has been determining in this field of fuel studies.

Figure 1 is an electron micrograph

Fig. 3. In this view of irradiated and non-irradiated coal, D is of 200-mesh coal, photographed by light microscope at 750 diameters, and E shows coal broken down to ½ to 3 microns, at 6750 diameters on the electron microscope

Fig. 4. Electron micrographs of 6750 diameters illustrate coal-oil and catalyst irradiation combination studies. Coal is finely dispersed in F, but in G, due to the use of a catalyst, there is the appearance of coal being solubilized in the oil mix, appearing as hydrocarbon chains

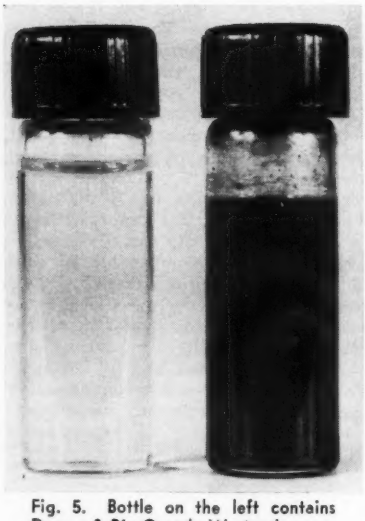


Fig. 5. Bottle on the left contains Denver & Rio Grande Western's economy fuel, and the other contains the economy coal and oil mixture used in the small diesel engine test described in the text

of: diesel fuel as received (A); gasoline as received (B); and a typical well dispersed fuel after treatment with dispersant (C). These were photographed at 6750 diameters. The particle size in (A) is very large. The particle size of the leaded gasoline in (B) is small but agglomerated in clusters, while the particle size in (C) is less than one-tenth micron. It has been found in these studies of particle size as related to internal engine combustion problems that, if fuel constituent particles can be sized to less than ¼ micron, much of the wear and deposit problems are eliminated, by combusting and burning these materials.

Coal ground to 250 mesh is shown in figure 2. Placed in cans, this coal is irradiated either with economy fuel oil, or by itself, and then mixed with economy fuel oil.

Figure 3 is a photograph of microscopic studies of the irradiated coal and non-irradiated coal. "D" is of the 200-mesh coal, photographed by light microscope at 750 diameters; "E" shows coal broken down to ½ to 3 microns, at 6750 diameters on the electron microscope.

This process of splitting coal particles to comparable particle size of conventional constituents in petroleum fuel makes it possible to use coal as a mixture with diesel fuel.

D & R G W is continuing the study actively and is finding, through the use of some catalysts, that it is able to secure better particle size of the mix and indication that the coal is going into solution.

Typical of this is figure 4, electron micrographs at 6750 diameters of coal-oil and catalyst irradiation combination studies. In "F" coal is finely dispersed; in "G" there is the appearance of coal being solubilized in the oil mix, appearing as do some hydrocarbon chains. Figure 5 is of the railroad's economy fuel, and of the economy coal and oil mixture as used in the small diesel engine test.

Particle Sizes—1/25,000 of an Inch

Generally speaking, the theory is that coal is composed of saturated and unsaturated hydrocarbons, heterocyclic compounds containing oxygen, nitrogen, sulfur, and aromatic compounds. The aromatic compounds are the primary constituents. In general, irradiation will result in degradation of the constituents of coal, resulting in turn in a decreased particle size. These particle sizes, which are being discussed and which D & R G W is attempting to use in a coal and oil mixture, are on the order of ½ to 1 micron size.

The Btu content of a pound of coal and a pound of fuel oil is about the same, roughly. If the railroad could burn ten percent coal in ten-cent diesel fuel, it would be equivalent to one cent per gal savings for the diesel fuel. If this percentage can be increased, then, of course, the savings are increased. The company's first aim is, of course, to use the ten percent mix. Burning an average of 5,000,000 gallons, or 40,000,000 lbs, of diesel fuel per month, the ten percent mix could mean using 4,000,000 lb of coal per month. This percentage then would be increased if the railroad could find a way in which it could secure more coal as colloidal material mixed with oil.

In closing, it should be noted that this is strictly a research project, purely exploratory and experimental in nature, but one which D & R G W feels offers great promise for the development of the use of solid fuels such as coal for most any type of internal combustion engine.

MINE CAR REPLACEMENT

(Continued fom page 77)

is being used because of the difficulty of stopping a trip and the excessive wear that developed with the old brake shoes.

3) A need has been realized for having larger and heavier locomotives, and a tandem locomotive building program has been started in the shops.

4) Cars are more difficult to rerail.

5) Since a new car has the equivalent capacity of three old cars, it is more serious to have any quantity of cars standing empty, standing with supplies or standing for repairs, due to having less cars (about 125 of the small cars were retained for general utility and supply service, but it is not always convenient to use them thusly).

6) Automatic couplers are designed to rotate and to swing from side to side, thus making a poor place for brakemen to ride in low coal.

7) Clearance in some older workings is more critical with the new cars.

Over-all Mining Costs Reduced Five Percent

In summing up, it is true the company's experience has been of short duration and many of the cost factors are intangible in nature. However, management is able to accurately ascertain over-all benefits amounting to a 33 per cent reduction in haulage costs and a 5 percent reduction in over-all mining costs figured in the railroad car.

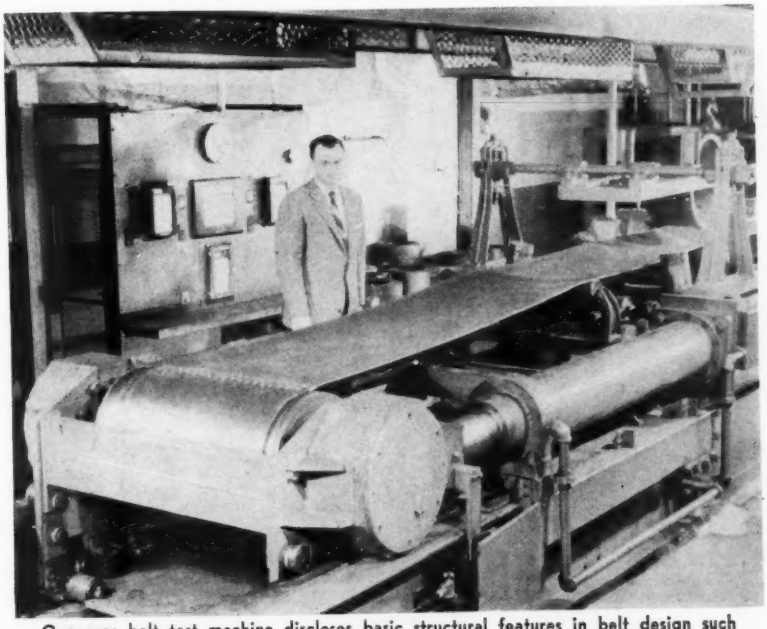
At the current rate, investment will be returned in 2½ to 3 years. Management feels the smooth transition to the new cars was the result of an adequate planning job. However, as the mining personnel become better educated in the use of the cars, Inland Steel expects to realize additional benefits in the future.

Installation of car feeder, electronic scales and rotary car dumper at head house. The scales were designed so that the weighing of coal could be coordinated with the activities of the car dumper, and one man currently weighs, records weights and dumps the material

CURRENT TRENDS IN HEAVY CONVEYOR BELTS

By A. ARGUEDAS
Conveyor Belt Engineer
Manhattan Rubber Division of
Raybestos-Manhattan, Inc.

Technical advances made in belt construction and equipment offer possibilities of longer centers, less transfers, and lower capital and maintenance costs



Conveyor belt test machine discloses basic structural features in belt design such as permanent and elastic stretch, splice holding durability, troughability, and impact resistance

THE main uses of conveyor belts in open-pit mining have been for the removal of overburden and for the haulage of ore from pits where the grades are such that rail or truck haulage is impossible or uneconomical. The typical installation involves a belt receiving material from trucks at some centrally located point in the pit and taking it up to shipping pocket, beneficiating plant or concentrator as the case may be. When the tonnage rates are high and the pits deep, high tension belts are required.

Conveyor belt handbooks published just a few years ago show that tensions up to 400-500 lb per in. of belt width could be handled with conventional cotton duck belts, tensions from about 500 lb to 900 lb per in. of width required either cotton cord belts, cord fabric belts or cotton duck belts made from a very special cotton that had received a treatment of both a chemical and mechanical nature. Tensions above 900 lb or 1000 lb per in. could only be handled by belts having steel cable strength members.

At the present time, belts made from fabrics woven from synthetic fibers are being offered for tensions up to 2000 lb per in. or 4 or 5 times conventional cotton belts. Most of these new belts make use of rayon fibers in the warp or lengthwise direction and nylon fibers in the filler or cross-wise direction. However, there is no reason why other new synthetic fibers, such as dacron, will not be used more in the future if they can become competitive with rayon on the basis of strength per dollar.

In the tension range of 2000 to 3000 lb per in. steel cable belts are still required.

One result of the use of high strength belts is the replacement of multiple flight conveyors by single flight conveyors.

Types of Strength Members

Apart from the type material used in the belt such as cotton, rayon, steel —high tension belt strength members could be classified into two basic

types: laminated structures and single layer strength member.

In the single layer strength member, cotton or steel cables carry the tension and additional body is obtained by use of envelopes of duck plies, but these are not load carrying plies. The primary advantages are troughability and freedom from bending stresses in outer plies when flexing around pulleys.

Laminated or plied belts consist of multiple plies of cotton, rayon or nylon cord fabrics or conventionally woven cotton or synthetic fabrics. (In this article fabrics having their strength concentrated in the longitudinal direction with only enough fill threads to enable the fabric to be handled easily during manufacture are referred to as *cord fabrics* and fabrics that have a substantial amount of cross threads as *conventional woven fabrics.*)

Plied belts have the advantage of ease of making vulcanized splices and repairs in the field using the same methods that have been used with duck belts.

The earliest high tension belts that didn't use steel cable were of the cord construction because, with the strength of fibers available at that time, it was necessary to concentrate the fiber strength in the longitudinal direction in order to obtain the tension rating and still have a belt that would trough and train properly in narrow widths.

With the development of higher tensile fibers, fabrics have been woven that will permit high tension and still trough. Belts of this construction can carry much higher loads when used with fasteners than cord belts can. This is an advantage, in the event of an accident to the belt, for temporary operation of the conveyor until the belt can be vulcanized.

There are any number of high tension belts that have been handling ore for several years now and some of these are listed in the accompanying table.

Improvements in Fiber Properties

High tensile fabric belts have been made possible primarily because of two things—improvements in strength and other properties of fibers that have been made by the textile fiber manufacturers, and the extensive work that has been done by the development departments of the rubber manufacturers using heavy laboratory belt testing equipment of an entirely different type than has been used in the past.

The rayon that is available today *looks* much the same as it did 20 years ago and its basic components are similar, but its properties are very much improved. The strength of Du Pont's rayon yarn, for example, has been increased from about 3.2 grams per denier to 5.0 grams per denier, and improvements have also been made in toughness and water sensitivity and other properties.

Perhaps the term grams per denier should be explained as well as some of the basic differences between rayon and cotton.

The absorbent cotton in your medicine chest pulls apart easily by hand, but if you give it a single twist it cannot be pulled apart. Conversely, a cord of fabric in a cotton belt can be untwisted to an extent that all that remains is soft cotton strands much like the cotton in the medicine chest. This is because cotton consists of many short hairs or staple lengths (½-¾ in.) which slip past each other unless they are twisted together into yarns and cords. Cotton, with its many fuzzy ends, adheres to rubber very well in its natural state.

High strength synthetic yarns, on the other hand, are made of very long continuous filaments, are very sleek and adhere poorly to rubber until treated with a resin and are strongest with no twist.

Belting Mfg.	Belt Width (in.)	Belt Type	Material	Conveyor Lift (ft)	Conveyor Centers (ft)	Belt Speed (FPM)	Motor HP	Belt Tension (PSI)	Belt Const.	Years in Service, Tonnages Handled
Goodrich	30	Steel Cord	Iron Ore	350	1642	590	400	1000	No. 1000 Steel Cords	10 years 10,000,000 tons
Goodrich	54	Cord (Fiber)	Copper Ore	111	796	425	450	665	No. 70 Cord 9 ply	8 years 60,000,000 tons
Goodrich	60	Rayon Nylon Fabric	Taconite Ore	89	307	595	500	675	80 RS 7 ply	2 years 20,000,000 tons
Goodyear	30	Rayon Fabric	Iron Ore	237	920	570	250	660	XXH Rayon 6 ply	2 years 5,000,000 tons
Goodyear	60	Steel Cable	Taconite Ore	280	926	395	1200	2000	No. 550 Steel Cable	2 years 21,000,000 tons
Goodyear	48	Rayon Fabric	Coke	19	5511	300	150	420	Heavy Rayon 7 ply	4 years
Hewitt	30	Rayon Nylon Fabric	Iron Ore	188	1020	570	250	780	Raynile No. 130 6 ply	4 years 7,500,000 tons
Hewitt	54	Rayon Nylon Fabric	Copper Ore	195	1720	498	750	1040	Raynile No. 130 8 ply	2⅔ years 30,000,000 tons
Hewitt	30	Rayon Nylon Fabric	Lime-stone	610	2100	275	250	1200	Super Raynile No. 200 6 ply	2⅓ years 900,000 tons
Manhattan	30	Rayon Cord	Iron Ore	382	1544	500	450	1500	Tension Master 10 ply	5 years
Manhattan	48	Rayon Cord	Copper Ore	219	975	440	450	780	A-45 Tension Master 5 ply	3 years 8,000,000 tons
Manhattan	42	Rayon Nylon Fabric	Copper Ore	130	589	400	225	540	A-90 Homoflex 6 ply	1 year
U. S. Rubber	36	Ustex-Nylon	Anthra-cite	643	2600	310	400	1050	7 ply Style CL	10 years
U. S. Rubber	48	Ustex-Nylon	ROM Coal & Rock	374	1580	306	250	880	8 ply Style CX	6 years
U. S. Rubber	36	Rayon-Nylon	Iron Ore	793	3791	460	700	1750	Usrex-Nylon	To be installed in 1958

The strength of rayon, nylon, dacron and other continuous filament fibers, is expressed in tenacity or grams of force per denier. Denier is a unit of weight. One denier is a filament 9000 meters long weighing one gram. Even a spider web is heavier than this. For rayon, five grams per denier is equal to about 99,000 psi.

The strength of any fabric depends, among other things, on how much denier per in. of width the designer chooses to put into it but this is only the beginning. These fibers must be twisted into yarns and cords and woven into fabrics and the conveyor belt designer must specify to the textile mills the amount of twist and crimp desired. Each of these affect the belt in a different way and many are interrelated.

The function of twist is to hold the yarn together, to prevent it from spreading apart. Twist introduces added resilience having a great effect on modulus and flex-fatigue of the belt. Regulation of the amount of crimp in both warp and fill yarns further effects the resiliency, stretch, and modulus of the belt.

In view of the different distinctive characteristics of synthetic fibers, conveyor fabrics are often a combination rather than being made of all the same fibers. Rayon warps are often woven with nylon fills. Cotton warps are often woven with nylon or rayon fills. Belts are made with fabric plies of one fiber inside and plies of another fiber outside again taking advantage of the specialized virtues of each fiber where it will do the best job. Therefore, one is likely to find it meaningless to specify a conveyor belt by naming any single component material. Even knowledge of the component leaves in question the multitude of ways to locate and proportion them.

New Conveyor Belt Testing Equipment

Although tensile capacity is essential, it is not the only requirement of a conveyor belt. A belt is not a tow chain and in addition to pulling the load, it must move, bend around pulleys, absorb shock and impact, trough and a lot of other things.

Too often, belt comparisons are based entirely on tension ratings and it is forgotten that a certain amount of "body" is required to stand up to the constant impact a belt is subjected to. To effectively study all of these factors requires more than just tensile testing machines or simple flex tests and many of the belt companies have installed machines that can test full width belts under various tensions.

Raybestos - Manhattan's conveyor belt test machine shown in an accompanying photograph was installed in 1949 at Passaic, N. J. The machine tests a conveyor belt 30 in. wide and 60 ft long running over 20 in. diameter head snub and bend pulleys. Belt speed forward and reverse is variable from creep to 2000 fpm. The troughing idlers are adjustable to any angle up to 60 degrees. The 20-in. tail pulley is mounted on a guided roller carriage positioned by two 7-in. hydraulic rams that develop and hold total operating tension up to 200,000 lb.

A large instrument panel records belt tension, speed, stretch and power, against hours of operation. The machine operates 24 hours a day with an automatic shut-off in case of belt failure. This type of laboratory test equipment discloses basic structural features in a belt design such as permanent and elastic stretch, splice holding durability, troughability, and impact resistance, before the belt goes into service.

Field Splicing of Conveyor Belts

Once the belt has been selected, the mine operators' chief concern is with the installation, maintenance and repair of the high tension belt. Every conveyor must be made endless in some manner before it can be used. This means that the belt splice is a major factor in successful belt operation. The amount of downtime that

The multiple flight conveyor is giving way to the single flight conveyor because of the technical advances made in belt construction and equipment. View shows one conveyor having 1642-ft centers and 350 ft of lift

can be expected with a conveyor belt will be directly affected by the durability of the splice and this should be kept in mind in the selection of the belt construction. A belt with the greatest number of plies will usually result in the best splice life as the stresses are spread out over a wider area.

In the splice, the fabric is not continuous. Each ply is interrupted and its load must be picked up by the remaining plies through the rubber bond. The remaining plies in the splice are subject to higher loading than in the body of the belt. This is so even in the straight-away portion of the belt and to this must be added the extra stress in the outer ply due to bending around the pulley. A splice must be made that will withstand all these tensions.

Earlier it was stated that the same basic techniques are used in high tensile rayon-nylon belts as in ordinary cotton duck belts. Although this is true, it is also true that extra care and expert workmanship must be used, the splicing materials must be absolutely fresh, and a good, dry working place be provided. The fabric may look the same as cotton duck but it must be remembered that each ply is carrying a much higher tension.

Both laboratory testing and observations of field failures indicate that splice failures are the result of fatigue in the rubber bond starting with the outer ply and working inward. With high tensile rayon fabrics, we rarely get rupture of the outer-ply fabric that was so common in cotton belts. Splice "tip lifting" and ply separation are more apt to be the cause of splice failure. These start out as blisters and fortunately they can be seen as depressions or blisters in the rubber covers. Therefore, a sudden splice failure is extremely unlikely if the splice area is examined regularly. This should be a definite part of the preventative maintenance program.

Stepped splice in high tension cord belt. Ends are overlapped and fitted together without increasing belt's thickness. Each step butts against corresponding step with no gaps or overlapping

It is recommended that belt inspection be made at a point where the bottom cover can be seen, as irregularities are made more obvious by the thinner bottom cover.

For the most economic operation of high tension conveyor belts, they must be operated at their maximum safe loads and care must be taken to eliminate overloads, slippage, excessive wear and damage. This means that special care must be taken in the selection of the conveyor components.

Although this discussion has been concerned with high tension belts, the many desirable characteristics that have been made possible by the development of these belts are also available for use on the replacement belts for existing low tension installations. The synthetic fibers have brought high strength, but more impressive is their superiority in elastic recovery, giving impact resistance, high flex-fatigue resistance and rip resistance. This means that belts with improved fastner holding ability, troughability, and impact absorption can be obtained, and these should be investigated so that you can be sure you are getting the most use per belt dollar invested in the standard tension as well as high tension belts.

DISCUSSION:

By MARTIN VANDER LAAN

Manager of Operations
Robbins Engineers Div.,
Hewitt-Robins

THE tremendous advances in the design and construction of conveyor belt described by Mr. Arguedas have had their impact on conveying machinery. What mining men are most vitally concerned with is . . . what do these advances and new techniques mean to them? . . . How can they profit from the new concepts of long conveyor haulage? . . .

During the present decade there has been a renaissance in the handling of materials. Today, belt conveyors are handling everything from alumina to people. To bring this progress into focus, visualize the belt conveyor a short decade or two ago. At that time, a 36-in. belt conveyor, 500 ft long, was considered quite a sensation. A 150 hp or 200 hp drive was the exception rather than the rule. Today 60-in. belt conveyors 12,000 ft long, handling 6000 tons of iron ore per hour, with a drive consisting of three 900-hp motors, or a total of 2700 hp, are being considered. Long haul belt conveyors with capacities of 3000 to 6000 tph, and speeds ranging from 600 to 850 fpm are becoming common place; in fact, certain experiments

using belt widths of 105 in. and speeds of 1000 to 1400 fpm are now being conducted.

Modern Conveyor Engineering

The long center conveyors made possible by modern belt constructions have been further augmented by new techniques in erection and route preparation.

Where formerly overland conveyors of any considerable length required several flights or sections of conveyors, which in turn required considerable cutting and filling to give the conveyor a straight gradient, now new drive mechanisms permit the conveyor to follow the contour of the ground (actually a roller coaster-like alignment) without breaking the conveyor into sections. These new drive mechanisms can be located anywhere along the conveyor. As you can well appreciate, a conveyor with a roller-coaster profile, can, under one loading condition require power like any ordinary conveyor, or again when the declined sections are loaded, the conveyor may actually drive itself and generate power. Newly developed drives automatically provide adequate driving tensions, regardless of any transient conditions.

The structural steel requirement for this type of conveyor is correspondingly simple since it is located on the grade and practically eliminates the need for expensive trusswork and supports. Because of the substantial investment in these high tension fabric conveyor belts, special measures are taken in the design to protect the belt from damage. The structural steel supports are spread wider than the conventional width to give additional clearance between the belt edge and the structural supports; further, the conveyor pulleys are provided with faces usually four to six in. wider than the belt width to permit the belt to run slightly off center without causing harm.

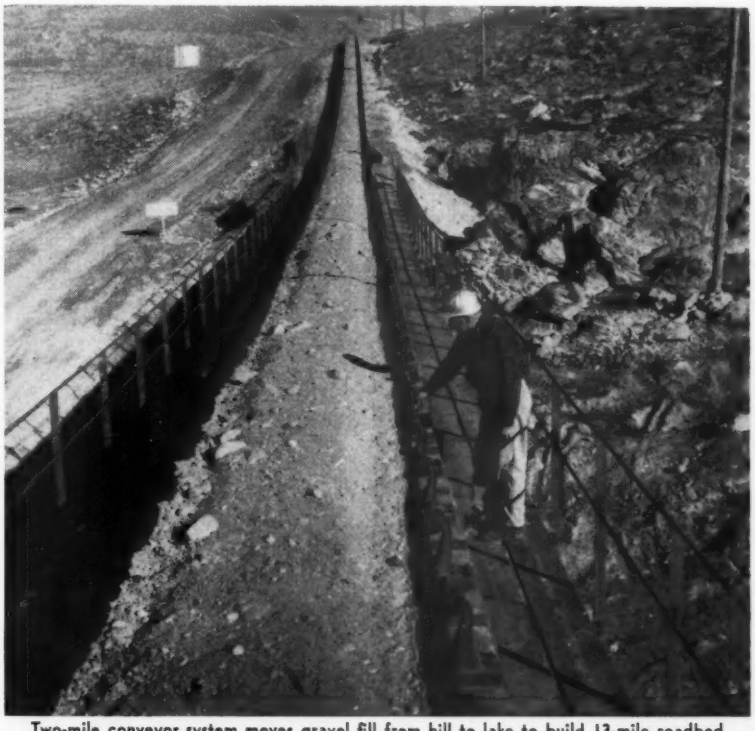
Side slip limit switches are provided so that any unusual mistraining of the belt automatically halts the system before it can be damaged.

Long center overland conveyors have eliminated costly transfers, with their attendant maintenance and operating problems. This reduction in transfers also represents a corresponding decrease in the number of operators who may have been stationed at important or difficult transfer points.

The utilization of these new high tension fabric belt constructions also simplifies the splicing crew and equipment requirement from that which would have been required if high tension steel cable belts were involved.

The use of acceleration or speed-up belts at conveyor transfers is another advancement. No longer it is necessary for the expensive mainline conveyor belt to absorb the punishment of a difficult transfer. The accelerating conveyor located directly over the main line conveyor takes the punishment on its heavy expendable belt and transfers it with minimum drop to the long main line conveyor. This permits the long and necessarily expensive main line conveyor to be selected according to the tension require-

At this dump station fill material for the Salt Lake crossing project is fed to conveyor system. Oversize stone is removed by vibrating screens and crushed to minus eight in. before going on conveyor



Two-mile conveyor system moves gravel fill from hill to lake to build 13-mile roadbed for Southern Pacific Railway across the Great Salt Lake. Long center overland conveyors have eliminated costly transfers, with their attendant maintenance and operating problems

ments without having to pay any premium for a heavier construction to withstand the loading impact.

Unique Application

Perhaps one of the most unique developments in modern conveyor engineering which has evolved from these technological advances has been the declined conveyor. These conveyors, transporting their burdens down hill, actually generate power which is harnessed to perform work elsewhere in the plant. For instance, a series of conveyors transporting ore downhill from a mine site generates over 1000 hp . . . enough power to run the primary and secondary crushers. Conveyors of this type are a challenge to the conveyor engineer. In this respect, one of the main line declined conveyors on the Salt Lake crossing project has nearly 1,500,000 lb of material moving at 850 fpm when fully loaded. The stopping of the decline belt requires a braking time of approximately 30 seconds. Accordingly, it was necessary to provide air cooled brake wheels to dissipate the heat generated during the period of decelleration. Although in this instance a satisfactory solution to the braking problem was found, it in itself created its own problem, whereby 35 tons of material were discharged over the head pulley of the conveyor while it drifted to a stop. In this case, sequential stopping was provided with a sufficient stopping time lag between succeeding belts to permit transfer of the drift discharge. Also, chutes were provided with sufficient capacity to contain this material during emergency stops.

One of the longest conveyor systems in operation in the United States is located underground in New Mexico. The system comprises a series of long conveyor units linked together underground for a distance of 7½ miles and carries potash ore from the continuous mining machines to the skip loading bins.

A Midwestern steel plant is presently installing a conveyor nearly 4000 ft long which carries quenched coke from the coke ovens to the blast furnace bins. This single flight conveyor spans a railroad freight yard and then crosses a river on a suspension bridge 126 ft above the water. This is another example of the reliability and continuous performance of the modern conveyor system.

These facts and figures should point up to mining men the tremendous possibilities of high tension belts and long haul conveyors. Members of the mining industry are on the threshold of realizing substantial lasting savings by utilizing this new concept in conveying.

There has been a terrific impetus in the development and application of the belt conveyor but it is only a beginning.

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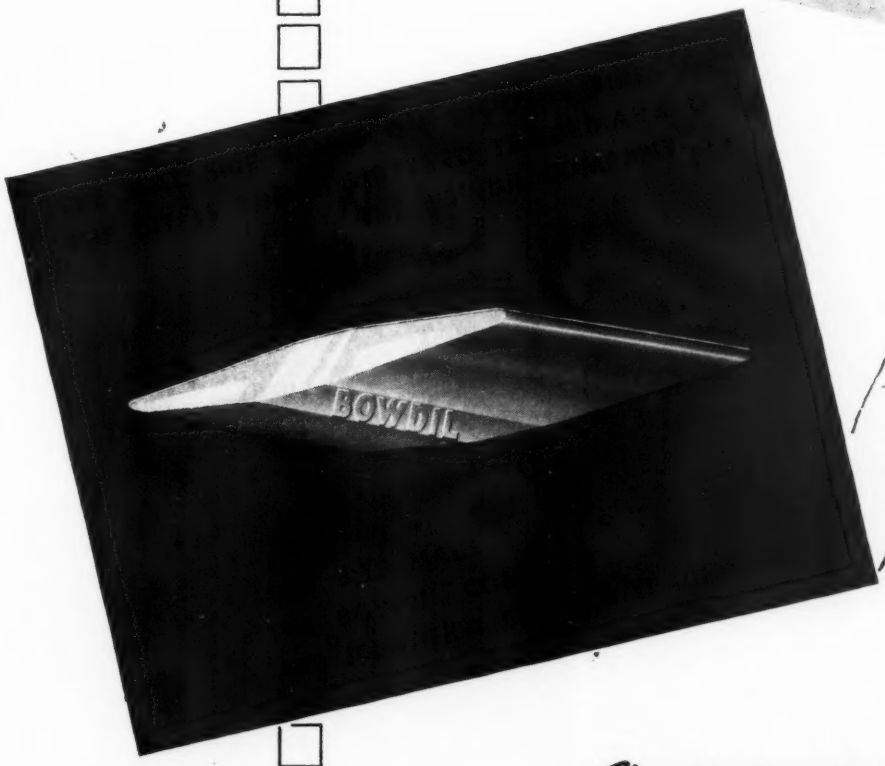

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Operators' Corner

Plastic Ducts for Mine Ventilation

By J. J. DALY
Engineer
Minerva Oil Co.

ADVANCING stope faces and the increased use of diesel haulage at the No. 1 mine of the Minerva Oil Co. prompted a study of auxiliary ventilation methods which led to the selection of a 48-in. blower fan and plastic tubing to improve face ventilation.

The No. 1 Mine of the Minerva Oil Co., Fluorspar Division, is located in Hardin County, Ill., about five miles north of the town of Cave-in-Rock. The mine was originally developed in 1942 and the orebodies consist of flat-bedded replacement desposits of fluorspar and zinc in the Renault limestone of Mississippian age. Ore deposition was controlled by a series of NE-SW striking fractures, which resulted in the formation of several long, tabular orebodies localized along the fractures and dipping at about four degrees to the northeast. Present production in the mine is limited to the larger East orebody, which has been opened by stoping for a length of 3500 ft, with an average width of about 250 ft and an average depth below the surface of 600 ft.

The mining method is essentially open breast stoping with pillars spaced irregularly, depending on ore grade and roof conditions. Average stoping height is 11 ft, and trackless equipment, in the form of mobile loading ramps and diesel powered trucks, is used in loading and haulage operations.

Primary ventilation for the mine is through the No. 1 main production shaft, located between the east and west orebodies, and the No. 2 air shaft, located about 700 ft south of the No. 1 shaft and bottomed in the east orebody stope. A 48-in. Aerodyne Junior fan is set at the collar of the No. 2 air shaft and delivers about 24,000 cfm of fresh air into the mine at 1¼ in. water gauge. Mine air is exhausted through the No. 1 main shaft.

Needed More Air

The central location of both the downcast and upcast air shafts created a problem in the circulation of sufficient air to the NE and SW production faces in the east orebody. This problem became increasingly serious as the stope faces advanced away from the primary air courses and as the number of diesel powered haulage trucks was increased. For a time, auxiliary ventilation was provided by the use of small, high speed centrifugal blowers, set at the collars of churn drill holes which bottomed in the production areas. However, the quantity of air delivered by one of these small blowers through a 6½-in. churn drill hole did not exceed 1500 cfm, and close spacing of expensive drill holes was found to be necessary in order to produce any beneficial ventilation effect at the production faces.

During the early part of 1957, provision of a satisfactory auxiliary ventilation system was studied and it was decided that this system should be capable of delivering about 12000 cfm to the production areas in either end of the east orebody stope. It was proposed that downcast air be circulated from the bottom of the No. 2 airshaft to the production faces through some type of duct system. The possible methods of circulating this downcast air included; bratticed air courses along one rib of the stope; use of small diameter metal tubing with high pressure blowers, and use of large diameter tubing with low pressure blowers. All of the methods considered involved considerable initial investment and the estimated costs of future extension of such ducts ranged from $4 to $10 per foot of general stope face advance.

Try Plastic Tubing

Before this study was completed, attention was drawn to the possibility of using a light plastic material, in the form of thin-walled flexible tubing of relatively large diameter, for the required duct. From the standpoint of estimated costs, the possibility was attractive but, because no information was available concerning the fabrication, installation, and performance of this type of tubing, a cautious step-by-step procedure was followed in exploring it.

It was felt that in order to decide whether such tubing would have practical value a number of points concerning it would have to be determined by trial. These points included developing a method of fabrication at reasonable cost, determining if the tubing could be installed in mine openings with a minimum of interference from mine operations and at a reasonable cost, testing the ability of the tubing to withstand the required pressures without splitting and

Auxiliary face ventilation is supplied by a 48-in. fan and 2000 ft of 54-in. diameter plastic tubing made at the mine

tearing, and proving that the tube could give an acceptable service life with low maintenance charges.

In developing a method of fabrication, a tube diameter of 54 in. was selected as being the largest size which could be installed in the mine openings without damage from mining operations; this diameter was also large enough to permit the use of low pressures and velocities in delivering the required quantities of air. The initial trial fabrication was made using four-mil thick clear polyethylene film in 16-ft wide sheets, 54-in. diameter hoops, formed from 1⅛ in. by ⅝-in. rough sawn elm wood strips, and acetate fiber tape, in two and three in. widths. Wooden hoops were mounted on a locally constructed mandrel, 54 in. in diameter and 60 in. in length, and were spaced at four-ft intervals. The polyethylene film was drawn over these hoops and stapled in place to form the tube. The longitudinal seam was sealed with three-in. tape, and two-in. tape was used to cover the film at the hoop locations. Stapling was then used to fasten the two-in. tape and the underlying film to the hoops.

Tubing was fabricated in 100-ft sections and a two man crew was able to produce it at the rate of 150 ft per shift. The direct cost per foot for the fabrication of this initial tubing was:

Polyethylene film	$0.30
Hoops and connections	0.16
Tape and staples	0.06
Labor	0.20
	$0.72

Successful trial fabrication of the tubing at a relatively low cost then led to making a trial installation underground for testing under actual service conditions. The tubing was hung on short wires, attached to eyed screws secured to opposite sides of each hoop; these short wires were suspended from two longitudinal wires which were supported by plugs driven into pin holes in the back. Installation was made in 100-ft sections and connections between sections were made by butting the end hoops together and securing the joints by eyed screws and wire ties. Because of the height of back, 10 to 12 ft, and the size and flexibility of the tubing, a four man crew was required to make the installation. This crew placed 200 ft of tubing per shift, including the drilling of pin holes. The direct cost per foot for installing the tubing was:

Materials—wire, screws, plugs	$0.08
Labor	0.30
	$0.38

The overall direct cost per foot for fabrication and installation of the tubing was $1.10.

Field Test

The trial installation was made to circulate air to the SW production area of the East orebody, from the bottom of the downcast No. 2 airshaft. A 48-in., propeller type fan, driven by a five-hp motor, was placed in the tubing intake; this fan picked up the downcast air and circulated it through the tubing, to the working area. Operating at 1100 rpm, the fan delivered 12,000 cfm of air through a trial tube length of 1200 ft.

The tubing is stapled to wooden hoops placed on 25-ft centers in the tube

A six month test period of service indicated that, while the tubing was capable of handling the required air volume, difficulty could be expected in maintaining the tube line. High humidity underground caused failure of the sealing tape adhesive, resulting in the loosening and opening of the longitudinal seam. Some success was achieved in reducing seam failure by using various types of plastic tapes and several types of seam coatings. However, no method was devised which could lower maintenance to an acceptable level.

The possibility of using a seamless extruded tube of polyethylene in the tubing fabrication had been considered earlier but had been rejected because of the difficulty expected in placing hoops in a continuous tube. Failure of efforts to make a serviceable longitudinal seam turned attention to the seamless tube again, and led to a trial in making it up locally.

Design Changed

Extruded tubing of four-mil clear polyethylene, 55½ in. in diameter, was used and, other than changing to a vinyl plastic tape, other materials were the same as those used in the initial tube fabrication. To avoid difficulty in placing hoops in a continuous tube, the tubing was made up in 25-ft sections which were joined together to make 100-ft lengths. A hoop spacing of eight ft was used and a mandrel, 54-in. in diameter and 10 ft long, was constructed locally for use in the work. The shaft of this mandrel was supported on moveable pedestals. This method of mounting allowed placing the polyethylene material and the prepared hoops on one end of the mandrel and removing the finished tubing from the other.

In making up the tubing, hoops were drawn onto the mandrel and spaced at the proper intervals. The polyethylene tube was then drawn onto the mandrel over the hoops. Two-in. vinyl plastic tape was used to cover the polyethylene at the hoop locations and stapling was then used to secure the tape and the underlying polyethylene film to the hoops.

Contrary to expectations, the production rate for the seamless tubing exceeded that for the sealed seam type; a two man crew was able to fabricate 250 ft of tubing per shift. The direct cost per foot of the seamless tubing fabrication was as follows:

Polyethylene tube	$0.30
Hoops and connections	0.11
Tape and staples	0.04
Labor	0.12
	$0.57

This cost represented a reduction of $0.15 per ft in direct fabrication costs, as compared to the sealed seam type of tubing.

In making the underground installation of the seamless tubing, a further reduction in cost was made possible because of the increase in hoop spacing interval. The installing crew was able to place 300 ft of tubing per shift, at a direct cost of $0.30 per ft. The overall direct costs for fabrication and installation of the seamless tubing amounted to $0.87 per ft.

Results Good

Following two months of successful testing of a trial section of 600 ft of the seamless tubing, the entire tube line was changed over to this tube type. Over 2000 ft of the tubing is now in service and results to date have been very satisfactory, both as to the ability to carry the required quantities of air and to operate with minimum maintenance. No failure of the tube has been observed, although the discharge end has been carried within 150 ft of the production faces, where severe blasting concussions occur.

Success experienced in applying this polyethylene tube duct to our low pressure ventilation requirements has been gratifying.

As Viewed by HARRY L. MOFFETT of the American Mining Congress

ALTHOUGH several major legislative items were only part way through the Congressional mill at the end of July, including the stabilization program to aid hard-pressed branches of the domestic mining industry, Congress was shooting for adjournment not later than August 15. The Senate, as usual behind the House in acting on legislation, was holding night sessions in an attempt to clear its agenda.

One measure which could squeeze through in the closing moments is a bill just drafted by the House Ways and Means Committee to increase social security benefits 7 percent and finance them with substantial payroll tax increases, reaching 4½ percent on both employer and employe in 1969. The Committee said that the tax increase is also required to pay for recent liberalizations of the social security program which have disrupted the "actuarial soundness" of reserve funds for future benefit payments.

The Administration has asked Congress to increase the Federal debt ceiling by $8 billion to $288 billion—the highest peacetime level in history. The request is based upon Treasury expectations of a $12 billion deficit for the fiscal year ending next June 30.

TRADE ACT GOES TO CONFERENCE

Five Senate and five House conferees were named late in July to compromise differences in the Trade Agreements Extension Act, passed by the Senate with amendments on July 22. A four-year trade program is generally expected to ensue.

Major Senate amendments would (1) shorten the extension to three years from the House-approved five years; (2) limit maximum tariff reductions to 15 percent—5 percent a year—with no carry-over of unused tariff cutting authority, whereas the House version would permit cuts of up to 25 percent and permit unused authority to be carried over; (3) restore the escape-clause procedure of existing law, in which Congress plays little part (the House version would permit Congress to override a Presidential decision provided a two-thirds majority were obtained in each House); (4) permit, in determining maximum escape-clause relief, the conversion of specific 1934 rates of duty to the then-equivalent ad valorem rates, which would make far greater duty increases possible; and (5) spell out a number of factors with respect to domestic industry which the Mobilization Director and the President must take into account in considering relief from excessive imports under the "National Security Amendment."

Prior to passing the bill, the Senate eliminated, by a vote of 63 to 27, an amendment approved earlier by the Finance Committee which would have required the President to adopt Tariff Commission recommendations for relief under the escape clause unless he obtained Congressional approval to reject or modify the Commission's recommendations.

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Washington Highlights

CONGRESS: Pushes mid-August adjournment.

TRADE ACT: Goes to Senate-House conference.

SEATON PLAN: Approved by Senate; reported to House.

DMEA EXTENSION: Exploration bill reaches House.

ASSESSMENT WORK: Annual deadline may be changed.

STATES' RIGHTS: House passes clarification bill.

PREMERGER NOTIFICATION: Bill on Committee agenda.

PENSION FUNDS: Committee approves bill.

WILDERNESS BILL: One-day hearing held.

COAL LEASING: Acreage-increase bill in conference.

BARTER PROGRAM: Senate and House disagree.

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SEATON PLAN REACHES HOUSE

The Senate passed in mid-July a revised version of the so-called Seaton plan to stabilize domestic production of copper, lead, zinc, fluorspar and tungsten, and the bill won the quick approval of the House Interior Committee after it adopted several amendments. The Rules Committee must now clear the bill before it can be scheduled for House action.

The measure would authorize Government purchases over a one-year period of up to 150,000 tons of copper at not to exceed 27.5 cents per pound, and stabilization payments over a five-year period to domestic producers of lead, zinc, fluorspar and tungsten. As approved by the House Committee, annual quantities on which payments would be made, stabilization prices, and maximum payments which could be made when market prices are below the stabilization prices are as follows: Lead—350,000 tons, 15.5 cents per pound, 3.9 cents per pound; zinc—550,000 tons, 13.5 cents per pound, 2.9 cents per pound; fluorspar—180,000 tons, $53 per ton, $13 per ton; tungsten—375,000 short-ton units, $36 per unit, $18 per unit. Minor additional payments would also be made on very limited quantities of lead, zinc and tungsten as an aid to small producers.

The House Committee provided that the program be financed through annual appropriations, rather than permitting the Secretary of the Interior to borrow up to $350 million from the Treasury for this purpose. Another Committee amendment would authorize the payment of limited production bonuses to domestic producers of beryl, chromite, and columbium-tantalum.

If the House passes the bill as thus amended the bill will go to a joint Senate-House conference committee to resolve the differences.

SENATE PASSES EXPLORATION AID BILL

The Senate last month passed and sent to the House a bill to re-establish a program of Federal financial assistance to private industry for mineral

exploration within the United States. The measure was later approved by the House Interior Committee, and House action is expected soon.

Although the new program would be generally similar to the now-expired DMEA operation, Government participation could not exceed $250,000 per contract and interest would be charged, at average Treasury rates plus 2 percent for administrative costs, from the date of the loan.

ASSESSMENT DATE TO BE ADVANCED?

The House Interior Committee has approved a bill to change the period for doing annual assessment work on unpatented mining claims, to make the deadline September 1 of each year instead of July 1. The committee, however, rejected a proposed one-year "moratorium" on assessment work.

HOUSE PASSES STATES' RIGHTS BILL

The House has passed and sent to the Senate a bill to assure that State laws will not be nullified just because the Federal Government has also passed laws on the same subject. The measure provides that if the Federal Government wants all the jurisdiction in a given field, a bill when passed by Congress must specify that all authority rests with the Federal Government.

The bill has been referred to the Senate Judiciary Committee, and its supporters hope the Committee will approve the House bill without amendment. If the Senate passes the measure with no changes, it can be sent directly to the President.

PRE-MERGER NOTIFICATION

The Senate Judiciary Committee is expected to consider shortly a bill which would seriously hamstring business. The measure would require companies planning to merge or a company planning to purchase over $2 million worth of another company's assets, to notify the Federal Government and then wait 60 days while Government attorneys determine if any antitrust laws will be broken. Because this would hamper acquisitions of reserves by mining companies, the American Mining Congress proposed an exemption for the purchase of reserves which is included in the bill.

Another bill which would hinder normal business transactions is on the Senate agenda and may be taken up at any time. It provides that a manufacturer, wholesaler or jobber could not cut his prices even to meet competition unless he could prove that in cutting his prices he was not doing it to drive his competitor out of business. Also, if he cuts the price to one customer, he would have to show that he has cut the price to all his customers in the same area. The bill applies only to food, drugs and cosmetics, but an effort will probably be made on the Senate floor to make it applicable to all businesses.

PENSION FUND BILL MOVES

The House Labor Committee recently approved a bill requiring that reports be made to the Secretary of Labor of all details of welfare and pension plans, whether administered by unions, management or jointly. It would cover all plans without regard to the number of persons covered. The Senate version of the bill would permit the Secretary of Labor to exempt plans covering 100 or fewer persons, and would give the Secretary the right to regulate and control such plans; the House bill provides only that the information will be filed with the Secretary. Under the House bill, all employes covered by a plan can demand a complete and up-to-date statement on the condition of the plan.

AMC OPPOSES WILDERNESS SYSTEM

The Senate Interior Committee held a hearing last month on a bill to establish a vast National Wilderness Preservation System on the public lands of the United States, but it has taken no further action.

Introduced by Senator Humphrey (Dem., Minn.), the measure contains a provision which would ban prospecting and mining within national forest areas in the Wilderness System unless specifically authorized by the President. In a statement to the Committee, Julian Conover, executive vice president of the American Mining Congress, urged that the bill be disapproved. "Any measure which would deter further mineral development through the curbing of the ardor of the prospector would result in a great disservice not only to the Western States but to the Nation as a whole," he stated.

Because of the short time remaining before adjournment, most observers believe the bill will not be acted on this year.

COAL LEASE BILL IN CONFERENCE

Joint conferees have been appointed to work out differences between the House and Senate versions of a bill to increase the maximum acreage of coal leases on public lands which can be held by an individual or company. Both Houses boosted from 5,120 acres to 10,240 acres the amount of land which could be held in any one State, but the House eliminated a section which would have permitted railroads to make commercial sales use of coal mined from public lands.

BARTER PROGRAM IN CONTROVERSY

The House and Senate have passed bills providing for sales of surplus agricultural products for foreign currencies, but disagree on whether to expand the barter of surplus commodities for strategic and critical materials. The House thinks the Secretary of Agriculture should be directed to barter up to $500 million worth of agricultural products each year; the Senate believes the program should be extended, but that there should be no direct orders to the Secretary to expand the program.

Secretary of Agriculture Benson is opposed to the House provision directing him to make such barters because, in his opinion, the barter program replaces sales which could be made for American dollars in foreign countries—sales which he feels are more advantageous to the United States than the barter program. The differences between the House and Senate will have to be worked out by a joint Conference Committee.

STOCKPILE UPGRADING FUNDS GRANTED

Senate and House conferees have agreed to give the General Services Administration $3 million for its use in upgrading stockpile materials, to be spent only if the agency believes such a program is worthwhile. The Senate had sought $10.5 million for this purpose. The Senate also had unsuccessfully sought $70 million to repay the Agriculture Department for strategic materials acquired under the surplus farm crop disposal program.

Book Reviews

RAPID ANALYSIS OF NONFERROUS METALS AND ALLOYS, G. Norwitz, Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y., 112 pages, $4.25.

Although the methods discussed in the book will save much time to the busy analytical chemist, speed has not been overemphasized. Short cuts, accuracy, simplicity, and reliability will make this book valuable not only to trained chemists but also to routine operators.

This book differs from other available books on metal analysis in that there is an increased reliance on sequence procedures; mathematical correction factors are used to advantage to eliminate lengthy separations; colorimetric procedures are extensively employed; great use is made of perchloric acid, especially for destroying organic matter.

EARTH FOR THE LAYMAN: By Mark W. Pangborn, Jr., American Geological Institute, 2101 Constitution Ave., N. W., Washington 25, D. C. $1.00

A selected annotated bibliography of the earth sciences, this Report No. 2 (second edition) is designed to help teacher, librarian, student, hobbyist and the nature-loving public to find suitable reading material in the fields of geology, mining, oil and mapmaking.

personals

A. L. Fairley

One of Canada's largest industrial organizations, the Dominion Steel and Coal Corp., has announced the appointment of **Albert L. Fairley** as executive vice president and director. He will also serve as executive vice president of the Dominion Coal Co., Ltd., and the Nova Scotia Steel and Coal Co., Ltd., Dosco subsidiaries.

At the time of his appointment, Fairley was vice president and director of the Shenango Furnace Co., and the Lucerne Coke Co., and vice president, general manager and director of the Snyder Mining Co.

Carl H. Cotterill has been named executive assistant in the executive department of American Zinc, Lead & Smelting Co. Since 1948 he has been plant and process investigator in the company's St. Louis office.

The Powhatan Mining Co. has announced the appointment of **Lawrence Flor** as assistant safety director of the Powhatan No. 1 mine in eastern Ohio.

Byron C. Hardinge has been appointed chief metallurgist for Magnet Cove Barium Corp. Before joining Magnet Cove in 1957, Hardinge served as development engineer for Hardinge Co., Inc. and also worked for the U. S. Bureau of Mines.

Richard T. Todhunter, Jr. has succeeded his father as president of Barnes & Tucker Coal Co. **Todhunter, Sr.** retired last January after 12 years as president of the Pennsylvania coal producer.

Robert D. Longyear has retired as president of E. J. Longyear Co. and Canadian Longyear, Ltd., and has been elected to the newly created position of chairman of the board. **Donald M. Davidson,** formerly vice president and manager of the Mining Division, has been elected president and chief executive officer of the two companies.

The U. S. Bureau of Mines has made awards to four men who have been outstanding in Government service. The U. S. Department of the Interior's Meritorious Service Award and Silver Medal were given to **Dewey A. Reynolds** and **Edward H. McCleary.** Reynolds, one of the men who originated the Bureau of Mines-American Gas Association method for carbonizing coal, retired from Government service last fall. McCleary, who is recognized for more than 15 years of superior service in Bureau of Mines health and safety work also retired last fall.

Howard B. Freeman was honored for noteworthy attainments in promoting the use of safe electrical equipment in underground mines with the Department of the Interior's Commendable Service Award and Bronze Medal.

William L. Crentz, Bureau of Mines chemical engineer, received a cash award from the Bureau in recognition of his role in organizing and obtaining American participation in the Third International Coal Preparation Congress at Liege, Belgium, June 23-29. As the only American member of the Congress organizing committee, Crentz was responsible for inviting and reviewing papers by American coal-preparation experts. He also was chosen to preside at the United States session of the Liege meeting.

Directors of the Glen Alden Corp., anthracite producer, have elected **Harry W. Bradbury** president to succeed **Francis O. Case,** who resigned. Bradbury, executive vice president in charge of coal operations for Glen Alden since April, was previously president of the Lehigh-Valley Coal Co. **Dudley G. Layman** was elected administrative vice president and treasurer of Glen Alden.

Merlyn Woodle has joined Reserve Mining Co. as assistant manager of the Babbitt Division.

Woodle's first mining work in Minnesota was in 1945, when he was employed as a pit foreman for Republic Steel Corporation. Two years later he became assistant superintendent of Minnesota Mines for Republic, and in 1953 he was advanced to superintendent.

Carlos J. Routh was named vice president for finance of Pittston Co. He had been serving as assistant to the president of the parent company.

Charles G. Quigley has been named head of the newly organized department of quality control of the Utah Copper Division, Kennecott Copper Corp., and **Wayne H. Burt** has been named superintendent of the Arthur mill.

Two changes were also made in the engineering staff of Kennecott's Western Mining Division. **D. J. Reed, Jr.** was named electrical design engineer and **Hans H. Pick** was promoted to process design engineer.

Felix du Breuil, former engineer in the mining research and development department of the Jeffrey Manufacturing Co., has been appointed project engineer for Bituminous Coal Research, Inc. He has been assigned to BCR's coal plasticity project at the Columbus, Ohio, laboratory.

Rudolph Ekar has been appointed chief mining engineer of Snyder Mining Co. following the retirement of **A. C. Borgeson. Maurie Erkkila** succeeds Ekar as assistant chief mining engineer. **Theodore J. Barker** was promoted to superintendent of the Whiteside mine succeeding **R. M. Baker.**

J. W. Dorff has been named general superintendent of Cannelton Coal & Coke Co. and Lake Superior Coal Co. At the same time **R. L. Turner** was named superintendent of Cannelton and **Naaman G. Clonch** was appointed superintendent of Lake Superior.

P. William Bakarian has been appointed president and general manager of R-N Corp., owned equally by National Lead Co. and Republic Steel Corp. At the same time **Rollin P. Smith** was named vice president in charge of engineering.

R-N Corp., at its experimental plant in Birmingham, Ala., has developed a direct reduction process for treating iron ores.

Jess Larson, retired Air Force general and former head of the General Services Administration, was named president of the Uranium Institute of America at its recent meeting.

C. B. Tillson, Jr.

Charles B. Tillson, Jr. former general superintendent of Crucible Steel Company of America coal mines, has been named assistant manager of the company's fuel division. In his new position he will exercise general supervision over the company's coal mines at Crucible, Pa. and Hugheston, near Charleston, W. Va., as well as river transportation.

W. M. Kelley has retired as president of Reserve Mining Co., jointly owned by Republic Steel Corp. and Armco Steel Corp. He had been president of Reserve since 1954.

The Reserve presidency will be alternated annually between an official of Republic and Armco, it was announced. **Charles M. White,** chairman of Republic's board of directors will serve as Reserve president for the ensuing year. **Robert J. Linney,** formerly vice president in charge of operations, was elected executive vice president.

Arthur Hall, superintendent of Allegheny Pittsburgh Coal Co. mine at Logan's Ferry, Ohio has retired. He had been superintendent at the mine for over 23 years.

Cleveland-Cliffs Iron Co. has announced the election of **Walter J. Tuohy,** president, Chesapeake & Ohio Railway, as a director. At the same time the company announced the election of **H. Stuart Harrison** as executive vice president.

Maurice D. Cooper, director of the National Coal Association's Mining Engineering Education Division, retired June 30. **Robert F. Campbell,** director of the Educational Section of the Public Relations Department at NCA has assumed his duties.

At the recent annual meeting of the National Coal Association, **Frank F. Kolbe,** president of The United Electric Coal Companies, was elected president succeeding **L. Newton Thomas,** president of the Carbon Fuel Co.

Earl O. Torgerson, consulting metallurgist of Salt Lake City, has been named project manager for Utah Construction Company's Korean venture. Utah Construction is contract adviser to the Korea Tungsten Mining Co., a Republic of Korea-sponsored firm which is building a large tungsten mine, concentrator and refinery.

Willis M. Johns has joined the staff of the Montana Bureau of Mines & Geology as geologist-in-charge of the field station that has been established at Kalispell, Mont.

Coleman W. Morton and **Henry H. Patton** have been elected to the board of directors of Sabre-Pinon Corp.

Patton, an associate in Kuhn, Loeb & Company, replaces **J. R. Dilworth,** a Kuhn, Leob partner resigned.

Morton is executive vice president and director of Capital Research and Management, which manages International Resources Fund, Inc., a substantial Sabre-Pinon stockholder. Morton is also a director of South American Gold & Platinum Company, Pato Consolidated Gold Dredging, Ltd., and Anglo-Ecuadorian Oil Fields, Ltd.

Homer S. Anderson, resident engineer, was recently appointed manager, Mining Department, of the New York and Honduras Rosario Mining Co.

Election of **Lyle S. Cline** as controller of American Metal Climax, Inc., has been announced. For the past nine years Cline has been an officer of Bucyrus-Erie Co., where he served as controller, vice president and secretary.

John F. Breitenbach, for two years assistant purchasing agent, Potash Company of America, has been promoted to purchasing agent for Potash Company of America's Canadian subsidiary, PCA, Ltd., at Saskatoon, Saskatchewan.

R. B. Hoy

Robert B. Hoy is now assistant to the chairman of the Earth Sciences Department of Stanford Research Institute, Menlo Park, Calif. He was formerly chief geologist for the northeastern United States for New Jersey Zinc Co.

Henri Pell Junod, partner in charge of coal for Pickands, Mather & Co., of Cleveland has been elected president of the American Coal Sales Association. Junod has been a vice president, director and member of the executive committee of the organization.

— *Obituaries* —

Robert Wallace, 74, former superintendent of the Midvale Smelter of U. S. Smelting, Refining & Mining Co., died June 2.

Lewis Stein, president of the Elliott Coal Mining Co., died of a heart attack June 13.

Clifford McIntosh, manager of mines for the Great Northern Iron Ore Properties, died June 20. Mr. McIntosh had been with Great Northern since 1920.

Hubert A. Cassell, 67, former official with the Pocahontas Fuel Co. died June 9. Mr. Cassell joined the Pocahontas Co. in 1915, rising to the position of division superintendent prior to his retirement in 1956.

Helmer Victor (Kyrle) Kruse, designing and construction engineer for Phelps Dodge Corp., died June 9, while on a fishing trip in northern Minnesota.

Born in Sweden and educated in Minnesota, Mr. Kruse spent most of his professional life in Arizona. He began his mining career when he was employed as chief mechanical engineer for the United Verde Extension Mining Co. and the United Copper Co. He later joined Phelps Dodge from which he retired three years ago as chief engineer. He continued as a consultant for the copper company in order to complete unfinished projects in the southern Arizona region.

Harold W. Dauber, 53, manager of marketing services for the Mining and International Divisions of Mine Safety Appliances Co., died July 8 of injuries received in an automobile accident.

F. A. Flodin, 55, president of Lake Shore, Inc., died June 20.

An Appreciation of Roy W. Moore

By George D. Dub

After a long illness, Roy W. Moore passed away on May 18, 1958, two days before his 74th birthday. His illness was a matter of constant concern to his legion of friends in all branches of the mining industry as well as to his family.

Roy's active career in mining covered a period of 47 years dating from his graduation in 1906 as a mining engineer from the University of Arizona until illness forced his retirement in 1953. Almost continuously during this period he was associated with Harvey S. Mudd, Seeley W. Mudd and Philip S. Wiseman. As a young man prior to 1913 he was employed as assayer, surveyor, churn drill helper and sampler at operations in Sonora, Mexico; Ray, Ariz., and Bryan Mound Sulphur in Texas. Then came a period of mine examination work followed by his selection as superintendent and manager of Goodsprings Anchor Co. at Jean, Nev., until 1919 when there again followed some mine examination work.

In 1920, Roy went to the United Eastern Mine at Oatman, Ariz., as mine superintendent and upon the retirement of John A. Burgess, he became the last general manager of that company.

Indefatigable and faithful worker, time was of small moment where problems of mining, milling, geology or just plain human beings were concerned. We, his associates, have sorely missed his company, his advice, his help since his retirement and express the hope that for him there now is only high grade in large quantities.

NEWS and views

Freeport Will Mine Sulphur from Steel Island in Gulf of Mexico

The world's first offshore sulphur mining plant is beginning to take shape with the erection of the first steel towers seven miles off the coast of Louisiana in the Gulf of Mexico.

When completed, the Y-shaped island will stretch for nearly one mile and reach 60 ft above the water. The structure, believed to be the largest steel island in the world, is the principal part of a $30,000,000 project undertaken by Freeport Sulphur Co. to develop a major new sulphur deposit known as Grand Isle.

Five large and ten smaller steel-pile towers, connected by 200-ft long bridge spans, will form the structure that is to support the complex and heavy facilities required by the Frasch process. The large towers will support the major installations—the seawater heating plant, three drilling platforms, and living quarters and recreational area. Two of the drilling platform units will be at the ends of the Y arms, while a third will be some distance from the main island. A total of 250 men will work five-day-on, five-day-off shifts and will be transported to and from the island by company helicopters.

The mine, expected to be in production in 1960, will be one of the largest sulphur mining operations in the world.

Winner of 'Sentinels of Safety' Awards Announced

Six mines and quarries in Kentucky, Michigan, Minnesota, Pennsylvania and Tennessee were recently named by Secretary of the Interior Fred A. Seaton as winners of the 33rd National Safety Competition sponsored by the U. S. Bureau of Mines.

On the basis of records submitted to the Bureau, the winners are: Republic mine of Republic Steel Corp.; a calcite limestone quarry of Michigan Limestone Division, U. S. Steel Corp.; Mississippi Group Mine of the M. A. Hanna Co.; Pine Knot colliery of Reading Anthracite Co.; Bellefonte limestone mine of National Gypsum Co., and Calloway-Mary copper mine of Tennessee Copper Co.

Secretary Seaton said 619 mines and quarries competed in the 1957 contest. The over-all injury-frequency rate for all contestants was 18.31 per million man-hours of exposure, the lowest recorded in the 33-year history of the contest. The over-all severity rate—4625.72 days lost per million man-hours of exposure—was an improvement over 1956 and was the third best rate in the contest's history.

Haile and Howe Sound to Merge

A proposal to consolidate Haile and Howe Sound Co. into a new Delaware corporation to be named Howe Sound Co. was approved by stockholders June 19. Under the terms of the consolidation each share of Haile stock is to be exchanged for 0.4 shares of the common stock of the new company, and each share of Howe stock to be exchanged for one share of the new company.

Howe and its subsidiary companies are engaged in the mining and concentrating of copper, gold, lead, silver and zinc, the mining and refining of cobalt and research in metallurgy. These operations will diversify and compliment the business of Haile which with its subsidiaries is currently engaged in producing tungsten concentrates and manganese nodules, the metals and minerals import-export business, the nonferrous metal brokerage business, the production of refractory materials and in fabricating aluminum building materials.

Drilling and Blasting Symposium

The University of Minnesota, in conjunction with the Colorado School of Mines and Pennsylvania State University, has announced the Eighth Annual Drilling and Blasting Symposium. It will be held at the University of Minnesota, October 2-4, 1958, inclusive, and is sponsored jointly by the three schools. Main topics to be discussed will include Recent Developments in Drilling and Blasting Practices, Problems Associated with the Use of Drilling Rods, and Drilling and Blasting Research.

For details of papers to be given and registration information, write to Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

100-Ton Coal Cars

On an eight mile stretch of railroad track near Clinton, Mo., 100-ton coal cars are hauling coal from the strip mines of Peabody Coal Co. to the Kansas City Power & Light Company's new Montrose Station.

These new cars, believed to be the world's largest, have a coal releasing mechanism which enables the load to be dumped in about 30 seconds. By moving a lever, two air-operated doors, each 11 ft 3 in. long and 40 in. wide, are opened to unload the coal by gravity into hoppers below the track. Another motion with the lever and the doors move back into the closed position.

Despite the increased size of the new cars, they meet all the requirements for operation over regular lines.

Canadian Firm Plans Drilling Program

Iron Ore Company of Canada this year expects to use nine drills to test a 30-sq mile area in the region north of Wabush Lake in Labrador on a concession held by Labrador Mining & Exploration Co., according to W. H. Durrell, executive vice president of Hollinger-Hanna Ltd.

Hollinger-Hanna is equally owned by Hollinger Consolidated Gold Mines and Hanna Coal & Ore Corp., and manages the operation of Iron Ore Co. of Canada.

On completion of this drilling, the final portion of the 250-sq mile area to be subleased in Labrador will be selected. Detailed mapping and surface sampling will be continued on the southern group of the known concentrating ore deposits lying immediately west of Wabush Lake. Additional bulk samples will be obtained for metallurgical tests.

DMEA Good Investment

Each dollar spent under the Defense Minerals Exploration Administration program which ended June 30 resulted in the finding of $23 worth of potential ore, according to T. H. Killsgaard, staff assistant for the DMEA minerals deposits branch of the U. S. Geological Survey.

DMEA was organized in 1951 to encourage exploration for critical and strategic minerals and metals through financial participation with private enterprise in exploration contracts. The Administration received 3852 applications for financial assistance and executed 1122 contracts approving work estimated to cost a total of $54,702,320, with maximum government participation of $33,688,513. Under the program, exploration for critical and strategic minerals has been conducted in 44 states (including Alaska).

The Senate has passed and sent to the House a bill to re-establish a program of federal assistance which is essentially a modification of the expired DMEA program. C. O. Mittendorf, administrator of DMEA, said that if the proposed legislation is enacted, 148 applications pending as of June 1, and those received during the month of June, not acted upon by June 30, would thereafter be considered for processing, at the request of the applicant, under rules and regulations that would be established by the DMEA.

Also . . .

South American Gold & Platinum Co., an international mining and exploration firm, has announced that its wholly-owned subsidiary, South American Placers, Inc., following agreement with the Bolivian government and approval of U. S. guaranties under the International Cooperation Administration, will embark on a large gold dredging operation in that country. The program represents a corporate investment of approximately $3,000,000, with production anticipated by the end of 1959.

Construction of a $1,000,000 molybdenum plant was announced by American Metal Climax, Inc. Situated at Coldwater, Mich., the plant will be owned and operated by Climax Molybdenum Co. of Michigan, a wholly-owned subsidiary of American Metal Climax. It is scheduled to go into initial production in the latter part of 1958.

A **38-mile pipeline** to handle coal is under construction in Russia, according to the *Engineering News-Record*. Coal will be first reduced to a "maize kernel" size at the coal pit before it is put into the pipe, the announcement stated.

The National Coal Association will construct an eight-story building in Washington, D. C., to house its own offices and those of other coal industry associations, according to NCA. The Association has occupied its present quarters in the Southern Building for 35 years.

New Jersey Zinc Co. has signed a $106,780 contract with the Defense Minerals Exploration Administration for further zinc exploration in the Treadway area of Hancock County, Tenn.

The lowest number of coal mine fatalities for any one single month since 1912—when monthly statistics were first published by the U. S. Bureau of Mines—was reported for March 1958. Fourteen deaths resulting from accidents in and around the nation's coal mines have been reported by the industry as having happened during that month. These fatalities occurred at the low rates of 0.42 per million tons of coal produced and 0.54 per million man-hours of worktime.

More than 20,000 miles of roof bolts were installed in American coal mines last year, according to the U. S. Bureau of Mines. Of the 358,000,000 tons of bituminous coal produced in 1957 in underground mining, about 180,000,000 tons, or more than half, came from roof-bolted sections.

Universal Atlas Cement Co., wholly-owned subsidiary, became a division of the U. S. Steel Corp. upon close of business June 30. This change follows a number of others made since 1950 in the interest of over-all corporate simplification.

Electrical World predicted a better than three-fold increase in the utilities' use of coal by 1975, following a special study conducted by the magazine.

The West Indies Island of Jamaica, world's number one producer of bauxite, increased its output by 41 percent with 436,000 tons of ore during 1957, according to a recent announcement by Jamaica Industrial Development Corp.

The European Coal and Steel Community plans to float a new loan of $40,000,000 in the American private capital market. The loan will be used by the community steel makers and mine owners to carry out projects of modernization and increased production.

The New Jersey Zinc Co. has shutdown its zinc mine at Ivanhoe, Va., and substantially reduced production at its nearby Austinville mine. The firm also announced that work on the development of the new Flat Gap mine, Treadway, Tenn., has been suspended. These actions have been made necessary, a company spokesman said, by the continuing oversupply of zinc from foreign markets at unrealistically low price levels.

The Coal Division of Eastern Gas & Fuel Associates plans to nearly double the size of its research laboratory at Everett, Mass. The facility conducts research on Pennsylvania and West Virginia coals, particularly with respect to their utility for making coke for domestic, metallurgical and foundry purposes.

A 75-acre deposit of peat, possibly the largest in northeastern Ohio, is being excavated near Bass Lake, south of Chardon. Aside from its commercial nature, the project is proving a community improvement from the standpoint of eliminating the peat bog, a mosquito breeding area. Life of the mine is estimated at 20 years.

The Glen Alden Corp. has reopened the Huber mine, Ashley, Pa., closed since April 1. The colliery, which formerly employed approximately 1500, reopened with 160 men initially. During the mine shutdown, the Huber breaker continued to process coal from other operations.

The Western Pennsylvania section of the Women's Auxiliary to the AIME is sponsoring and financing a "Pilot Student Venture" as the first step of a program to interest secondary school students in mining, metallurgical and petroleum engineering. Student interest is to be encouraged by organized exposure to the challenges of these professions through field trips. These visits will be followed by the women's auxiliary with a campaign designed to foster and encourage interest sparked by the field trips. Finally, the women stand ready to provide scholarships to worthy students who need funds for college education.

The George S. Rice Memorial Library, named for one of the nation's foremost pioneers in mine safety, was dedicated June 19 at the Bureau of Mines' Anthracite Experiment Station, Schuylkill Haven, Pa. Dr. Rice, the Bureau's first chief mining engineer, died in 1950 after a long career, much of which was devoted to studies of mining technology and safety problems in Pennsylvania's anthracite region. The wealth of technical material at the Library will be available for reference to industry, students, and others interested in coal technology.

A $100,000 pilot plant in Ottawa is being used by Canadia Alumina Corp. to test the feasibility of extracting alumina from slate formation in Nova Scotia.

Eastern Gas & Fuel Associates has announced completion of a new 267-ft shaft with skip hoisting facilities at its Federal No. 1 mine at Grant Town (near Fairmont), W. Va. The new facilities will raise production capacity of the mine from 10,000 to 12,500 tons per day. The present coal shaft and hoist at Federal No. 1 will be retained for ventilation and handling large equipment that goes into the mine.

Coal Mine Inspector Examinations

The United States Civil Service Commission has announced an examination for Coal Mine Inspector for positions with the Bureau of Mines located throughout the coal mining sections of the United States. The entrance salaries range from $5,440 to $7,570 a year.

To qualify, applicants must pass a written test and have had at least five years of practical experience in the mining of coal.

Full information regarding the requirements and how to apply may be obtained at many post offices throughout the country, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted by the Board of U. S. Civil Service Examiners, Bureau of Mines, Department of the Interior, Washington 25, D. C., until further notice.

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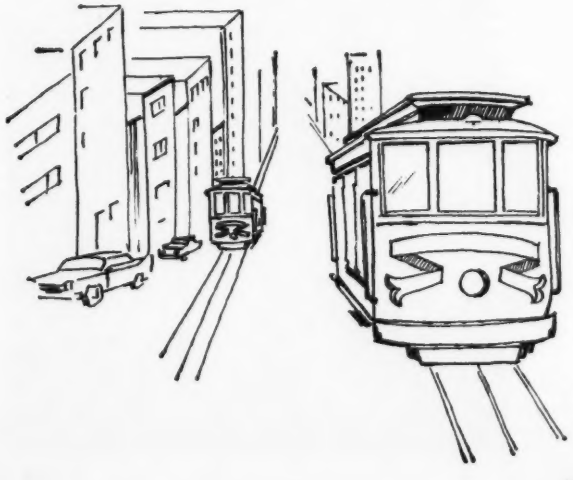

Come to San Francisco for the 1958 Mining Show of the American Mining Congress, September 22-25. You'll be glad you did!

See all the latest machinery, equipment and other essentials for metal mining and industrial minerals production—completely filling the Civic Auditorium, the new Civic Center Exhibit Hall, and a large outside area for equipment too large to be shown inside. The exhibits of more than 170 manufacturers will be there for your first-hand inspection and study—an exceptional opportunity to talk with the exhibitors' representatives about the operating characteristics of their equipment and its application to your own problems.

Hear leading mining men, prominent members of Congress, and top-level government officials discuss today's important mining problems—from national minerals policies . . . labor relations . . . taxation . . . strategic minerals . . . gold and silver . . . special problems of industrial minerals . . . uranium policies and developments, etc. . . . to the practical problems of underground and open-pit mining and quarrying, safety and health, and minerals beneficiation.

No registration fee, except for representatives of non-exhibiting manufacturers and suppliers. If you are an authorized dealer or distributor for one or more exhibitors, you can arrange with them for your free registration.

Don't miss the opportunity the 1958 Mining Show offers you!

Hotel reservations may be made through the AMC Housing Bureau, c/o San Francisco Convention and Visitors Bureau, Room 300, 61 Grove St., San Francisco 2, California. A deposit of $10 per room must accompany each application.

For further information please write

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NEWS and views

Uranium Expansion Expected

Allen E. Jones, manager of the Atomic Energy Commission's Grand Junction office predicted that the production of uranium oxide—now about 10,000 tons a year—should be "in the order of 20,000 tons" by mid-1960. "This annual rate of production will amount to $320,000,000 to $360,000,000 a year," Jones continued. "By today's standards or any other standards, this must be considered a substantial industry."

The AEC's go-ahead on private sale of uranium ore and concentrates, announced May 8, has resulted in every company now producing uranium receiving inquiries from domestic and foreign purchasers.

Thor-Westcliffe Development, Inc., of Santa Fe, New Mex., received the first license for sale of natural uranium materials, and immediately began plans for construction of a refining plant in New Mexico to process uranium ores to reactor grade material.

H. J. Guthmann, president of the Santa Fe Uranium Co., said "the issuance of this license to Thor-Westcliffe, now guarantees that American uranium ores will play a major role providing the fuel for atomic power programs throughout the free world."

Along this line, officials of the Chalk River plant of Atomic Energy of Canada, Ltd. announced they are confident they have developed a simplified nuclear reactor capable of producing electrical power at a competitive price in Canada. "We feel we have reached an objective of years of research and can now design a nuclear power plant to generate electric power at six mills per kwh," Dr. W. B. Lewis, vice president of AECL said. The Canadian experts believe that the new process they have devised will accelerate the building of nuclear power plants not only in Canada, but in the U. S., and other countries.

Large Scale Aggregate Beneficiation

Concrete engineers at the multi-million dollar Glen Canyon dam in northern Arizona have succeeded in beneficiating concrete aggregate on a large scale. A heavy media separation plant for the job was designed and assembled for Merritt-Chapman and Scott Corp., prime contractor for the dam and powerhouse, by Southwestern Engineering Co. of Los Angeles.

A mixture containing 75 percent ferrosilicon and 25 percent magnetite is fed with the raw aggregate into a separation tank. The undesirable float material is removed from the heavy mixture while the aggregate sinks to the bottom of the tank, to be washed, screened and stockpiled for use.

The heavy media plant now in operation moves some 100 tph of aggregate, 25 tons of which is separated sand. This beneficiated rock, only 10 percent of an estimated 10,000,000 tons of aggregate to be used in the dam, will go into the exterior of the dam, powerhouse and tunnels, where exposure to weather and water might otherwise erode the concrete.

New Copper User in Operation

America's newest, most modern brass mill was formally opened last month at Paramount, Calif. by the American Brass Co., wholly-owned subsidiary of the Anaconda Co. Shown is the casting of molten copper into a tube billet mold from one of the largest furnaces in the non-ferrous metals industry. The new plant can produce 30,000,000 lb of copper and copper alloys annually in the form of tube, sheet, strip, rod, drawn products and special shapes.

Atomic Blast May Open New Harbor

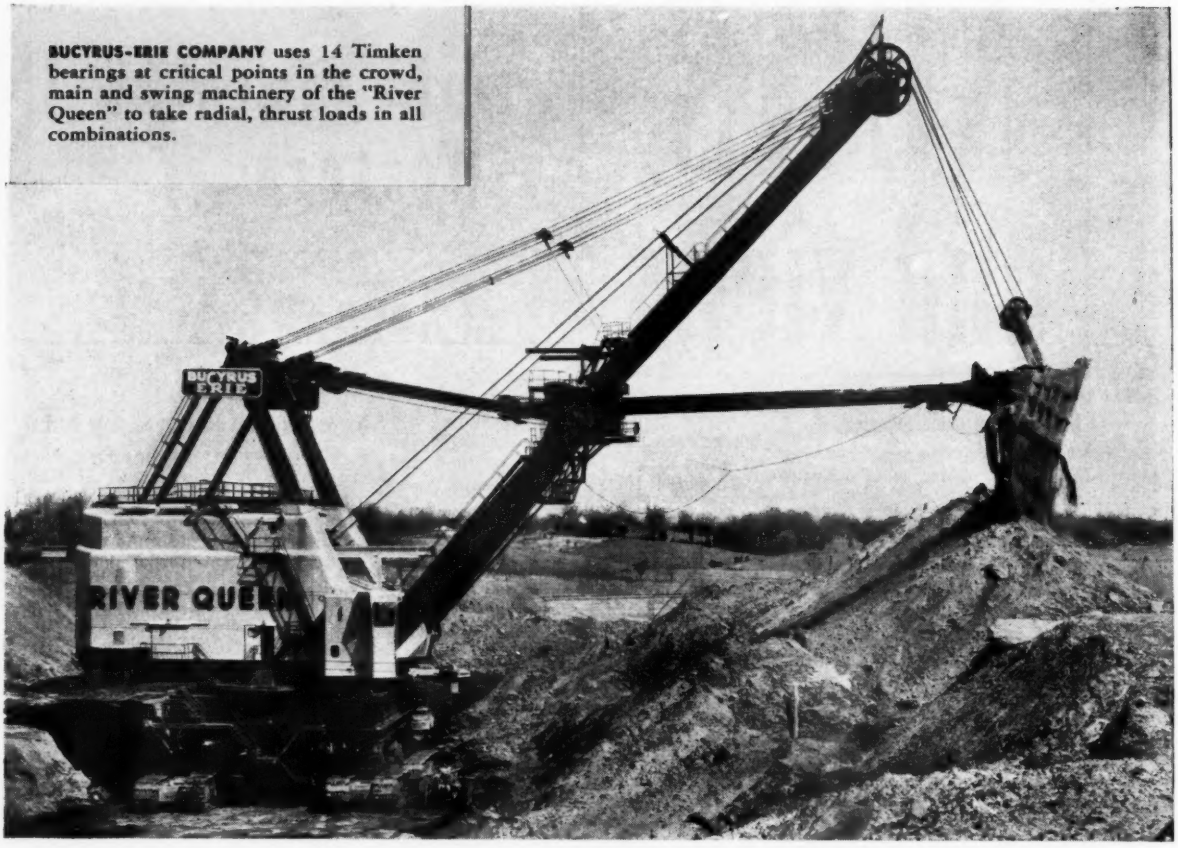
The feasibility of digging a harbor in northwest Alaska with an atomic explosion will be studied by the Atomic Energy Commission. If field studies show it's safe and practicable, the explosion could take place in 1960. The studies are part of the AEC's plan designed to develop peaceful uses for nuclear explosives.

Survey parties, including personnel from the Univerity of California Radiation Laboratory, will obtain detailed information on a spot between Cape Seppings and Cape Thompson, north of the Arctic Circle.

Raton Mine Fire Under Control

Following a $900,000 remodeling program, fire broke out at Kaiser Steel Corporation's Koehler coal mine near Raton, New Mex., on June 8. The fire was believed to have been started by an electrical short caused by a cave-in. Mine entrances were immediately sealed with cinder blocks to keep fresh air from the mine. During the first two weeks over 300 tons of liquid and solid dry ice were introduced into the mine. The use of dry ice was recommended by U. S. Bureau of Mine officials to reduce oxygen in the mine. On the third week chemical foam in the form of tough water-carrying bubbles was fed into the mine. A crew equipped with oxygen masks went 200 ft into the mine and discovered the cave-in area. They also discovered that the fire had either been smothered or had otherwise become inactive. It was too soon, however, to tell if the fire was completely extinguished.

No further applications of foam plug were planned until crews advanced nearer the fire area. Repair work was in progress by crews using masks and working in front of cement block seals as they advanced into the mine, cleaning out debris and replacing supports. Company officials were unable to assess the damage until the extent of the fire and cave-in and the effect the fire has had on underground equipment were determined.



BUCYRUS-ERIE COMPANY uses 14 Timken bearings at critical points in the crowd, main and swing machinery of the "River Queen" to take radial, thrust loads in all combinations.

Giant shovel swings 80-ton bites 300 ft., stacks 'em 100 ft. high, 14 TIMKEN® bearings take the loads

IT'S a whopper!—this Bucyrus-Erie 1650-B stripping shovel. It weighs in at over 2,400 tons, rises 140 ft. high. Taking 80-ton bites of overburden, it can pile up a "mountain" of 100,000 tons in a 24-hr. period. 15 electric motors power the giant, one of the largest mobile land machines ever built in the U. S. Yet one man in an air-conditioned cab controls the entire digging operation.

To take terrific radial and thrust loads 14 Timken® tapered roller bearings are used at critical points in the crowd, main and swing machinery. Their tapered design enables them to take any combination of radial and thrust loads. The full-line contact between rollers and races gives Timken bearings extra load-carrying capacity, too. And they shrug off shock loads; they're case-carburized to have hard, wear-resistant surfaces and tough, shock-resistant cores.

Timken bearings are geometrically designed to roll true. And they're precision-made to live up to their design. They virtually eliminate friction. And by keeping housings and shafts concentric they make closures more effective. Dirt stays out; lubricant in.

We even make our own electric furnace fine alloy steel, for extra quality control. No other American bearing maker does. For your No. 1 bearing value, specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD

Also . . .

Hecla Mining Co. has resumed work at the old Livingston property of Idaho Custer Silver-Lead Mines, Inc., in the Boulder district of Custer County, Idaho. As soon as the pumping-out operation is completed, crosscutting toward the areas where diamond drills intersected favorable ore showings last year will get under way.

A **$3,000,000 contract** for fabrication of a power plant addition to the Chino Mines plant of Kennecott Copper Corp. at Hurley, N. M., has been awarded the J. F. White Engineering Corp. The power plant addition will have a 16,500-kw capacity. Its construction involves a single power boiler and steam recovery equipment, power piping, turbine generator, electrical installations, powerhouse building and all accessories.

Spokane National Mines is resuming work at Washington properties it obtained by absorbing Dahl Uranium, Big Smoke Uranium and Universal Mining companies in a merger last December.

Great Northern Railway and Pacific Power & Light companies recently announced a joint sponsorship of a comprehensive mineral exploration and geological mapping project in Flathead, Lake and Lincoln Counties, Montana, in cooperation with the Montana Bureau of Mines & Geology. Goal of the five-year program is the location of mineral deposits and other raw materials that can be developed by industry to help stimulate the expansion of the economy of the western Montana communities served by the two companies.

Four Northwest mining companies —Grandview Mines, Silver Dollar Mining Co., United States Foreign Corp., and Metaline Mining & Leasing Co.—have purchased stock interests in Great Petroleum Corp. So far, the joint venture has produced four wells in Oklahoma—all with unusually low costs. Allowable production is only 15 bbl per day from each well, but there is room for 31 wells on the 320 acres now held in the area and the 320 additional acres that have been leased.

United States Lime Products Corp. has opened its new $2,000,000 lime processing plant at Arrolime near Las Vegas, Nev. The 400 tpd plant has been under construction since July, 1957. Limestone is quarried from a large, high-grade deposit adjacent to the plant.

One of the largest building materials companies in the United States, Flintkote Co. of New York, has acquired Utah Limestone Co. in a stock transaction whereby Flintkote is issuing 19,125 additional shares of common in exchange for all outstanding shares of Utah Lime. The deal gives Flintkote the high calcium limestone and dolomite quarries, flux plant and dolomite plant operated by Utah Lime and employing about 46 persons near Tooele, Utah.

Skin divers have been reported recovering gold from the bottom of the fast moving rivers near Sacramento, Calif. One of these modern day prospectors said he usually makes about $25 during a weekend with his fascinating hobby. For safety, two men work together. One slips into the churning water and disappears underneath with the shovel, spoon and canvas bag while the other, with a gold pan, stays above the surface. Once under the water, the diver looks for large rocks where gold might have been deposited in the crevices. Working in a sponge rubber suit, equipped with aqua-lung, plastic face mask and foot fins, he digs in the crevices with a spoon and fills the canvas bag which he sends to the surface. Up above his buddy pans the mud to separate the gold from the mud and rocks.

A new $2,000,000 clay products plant owned by Gladding, McBean & Co., and located at Mica, Washington, is "a reflection of the confidence of the firm in the continued growth of the Pacific Coast area," a company official said. The new plant at Mica includes nine buildings and a 400-ft long kiln. Its products will include face brick, drain tile, flue lining and other heavy clay items.

Smelting of Indonesian tin concentrate at Texas City, Texas, will be done by the Wah Chang Corp. The smelter, acquired from the government a year ago, has the capacity to smelt all the country's tin requirements, providing the company receives sufficient tonnages of tin concentrates.

A five-year mineral exploration and geological mapping project in Flathead, Lake and Lincoln counties in Montana will be jointly sponsored by the Montana Bureau of Mines and Geology and the Great Northern Railway and Pacific Power & Light Companies. Great Northern and Pacific Power announced they will finance the establishment of a Bureau of Mines and Geology field office at Kalispell from which a staff of geologists will direct the program, and will also have trained geologists and industrial engineers assigned to the project as the work progresses.

The third and fourth uranium mills to be completed in the Ambrosia Lake area began operation recently. Homestake-Sapin Partners started a 1750 tpd mill, and Phillips Petroleum Co. commenced processing ore from its Ann Lee mine in a 1725 tpd plant. Both mills are north of Grants, New Mex.

The Mayflower mine of New Park Mining Co., backed by the DMEA, has begun a $715,185 search for new reserves of lead-silver-zinc-copper ores. Contracts for driving some 8600 ft of drifts and cross-cuts in the west section of the mine will be completed with the contract mining crews. 10,000 ft of exploration diamond drilling in 20 holes and 20,000 ft of long hole exploration drilling in 75 other holes will also be undertaken. The project is one of the largest approved in recent years for the Park City district. If any ore is discovered, the government's loans will be repaid out of ore sales.

Radium King Mines, Inc., will be merged into Hidden Splendor Mining Co. in a reorganization and merger of that firm with other uranium companies controlled by Atlas Corp.

A switch in production goal was recently announced by Central Farmers Fertilizer Co. at its new multi-million dollar Georgetown, Idaho, phosphate plant. The firm will now undertake the production of triple super phosphates instead of high analysis calcium meta-phosphate, as originally announced. The company will thus become the first major U. S. producer of high analysis fertilizer from elemental phosphorous outside of the Tennessee Valley Authority. A spokesman for CFC said the change to triple super and phosphoric acid production was made solely to satisfy the demands of those members in the Western Fertilizer Association, whose members joined CFC in the Georgetown project.

A 75-ton carrier for hauling phosphate ore will be put into operation next year by Monsanto Chemical Co. Believed to be the largest of its type in the United States, the new carrier will handle a load three times the capacity of present units. Seven of the new carriers will displace fifteen now in use.

The first piece of potash ever mined in Canada was brought to the surface from the 3300-ft level at a drilling site 15 miles east of Saskatoon, Saskatchewan. The potash represents the culmination of a $20,000,000 investment, years of exploration, two years of shaft sinking and the building of a surface plant by the American Potash Co., Ltd. The operation is scheduled to start production on November 1.

The Supreme Court has ruled that the United States is not liable for damages to 252 gold mining companies it temporarily put out of business during World War II. The 7 to 2 decision reversed a U. S. Court of Claims finding in favor of six companies on Feb. 20, 1956.

Utah Ore Sampling Co. of Murray, Utah, has closed its doors after nearly fifty years of work for the minerals industry in the Intermountain Area.

Scholarships and fellowships awarded by Kennecott Copper Corp. take into account that tuition costs cover only a small part of the cost of education. Kennecott makes an equal award to both the student and to the college. The company's educational aid program has been set up in the belief that a reservoir of able and intelligent men in training at both undergraduate and graduate levels is essential to the mining industry and to the industrial welfare of the country.

Interest in ceramic research involving lead has increased. Lead imparts many useful properties to ceramics, and the growing understanding of how easily and safely lead products can be handled contribute to this interest. Seven research grants are provided by the Lead Industries Association for graduate study on the use of lead in ceramics.

Ninety-eight percent of the nation's columbium-tantalum concentrate produced in 1957 came from the Porter Bros. Corp. placer mine and mill operation in Idaho's Bear Valley. Over 370,000 tons of concentrates were shipped by Porter Bros. last year bringing U. S. production up 71 percent over the previous record set in 1956.

Oil shale operations of the Union Oil Co. at Grand Valley, Colo., have been suspended for an indefinite period. Company officials said commercial shale operations would depend entirely on economic conditions, including availability and price of foreign crude oil, and enactment of federal legislation giving oil shale a tax break similar to that given crude production. They further stated that Union Oil is now able to provide oil shale products to the armed forces almost at once if incidents such as the Suez Canal closing should cut off foreign oil.

A program of renegotiation of all domestic uranium milling contracts has been started by the Atomic Energy Commission. The AEC is prepared to commence work on extending such contracts from March 31, 1962 to December 31, 1966, whenever proposals are submitted to the agency. The 1962 to 1966 program involves only the purchase of concentrates. The ore buying program will be ended. Eventually, the AEC looks forward to an open, competitive market in the sale of concentrates during the next eight years, or at conclusion of 1966. This 1962 to 1966 program is aimed mainly at keeping the domestic uranium mining and milling industry in a productive position until demand for fissionable materials can be sustained by nuclear energy requirements.

A 200 tpd beryl mill will be built by Estes Park Beryllium Corp. of Loveland, Colo., and Cordillera Mining Co. of Grand Junction, in the Crystal Mountain area. The operation will make a total of three mills in northern Colorado. The American Beryllium Corp. mill at Masonville started production last week. Another beryl mill, owned by Mineral Concentrates, Inc., is now under construction at Loveland.

"Every effort we put into the SAVINGS BOND PROGRAM will be richly rewarded..."

a statement by ***Julian B. Baird,*** *Under Secretary of the Treasury*

"America's great productivity has been made possible by the willingness of Americans to save a part of their incomes for investment in productive enterprises. The Payroll Savings Plan of the Savings Bond Program implants and helps to sustain the habit of regular savings, and this benefits our whole economy as well as each individual saver.

"We need savings as a continued affirmation of our way of life. The right to build up personal savings and to choose individually our savings objectives is one of our cherished freedoms.

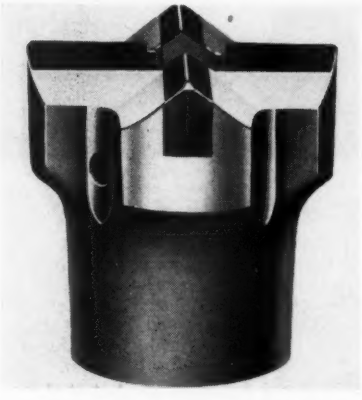
"I am convinced that every bit of effort we put into Savings Bond promotion as part of a broad thrift plan will be richly rewarded in the contribution we shall be making to the strength and security of our country in this critical period."

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR BELOW

manufacturers forum

Rock Bit

THE CUTAWAY TYPE carbide Rok-Bit has self-clearing chip channels and fast cutaway wings, report-



edly designed to minimize "drag" and "binding". The bit is available in gauge sizes 1½ in. through 4 in. For further information write to Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill.

Drill

A FOUR-INCH Blue Brute Drifter Drill with standard, neutral and reverse rotation has been announced by the Contractor's Tool Sales, Worthington Corp., Holyoke, Mass. While retaining all the basic features of Worthington's current drilling units, the new drill is interchangeable with drills now in service, including Worthington wagon drills, Port-A-Tracs and hydraulic booms on tractors and trucks. This interchangeability is said to result in economical conversion of existing equipment for rock drilling with sectional coupled steels.

Trolleyphone

WITH ALL PARTS OF PLUG-IN CONSTRUCTION for quick replacement to minimize downtime, the new Model 3000 Femco Trolleyphone consists of a smaller more ruggedly built transreceiver unit housed in a steel case, a heavy-duty industrial speaker and a new Femco microphone. Power is taken from existing trolley wire or power line, either 250 or 550 volts d-c. Current drain is about ½ amp. Installation can also be made for 110 or 220 volt a-c single or three phase, or from 6 to 40-volt batteries. The model 3000 is manufactured by Femco., Inc. Irwin, Pa.

Drill Hole Survey Kit

FOR TESTING THE INCLINATION and direction of drill holes, Exploration Methods, Inc. has announced a diamond drill hole survey kit including the Maas drill hole compass and a goniometer plus the necessary accessories. The Maas compass operates on the gelatine principle which locks the compass needle in place after it has been lowered to the selected testing depth. Inclinations are measured by the hydrofluoric acid method. E.M.I. Goniometer is a pocket-sized instrument for convenient field use. Also available are the non-magnetic clinometer case and diamond drill rods for testing EX, AX, BX, and NX size holes.

For further information write to Exploration Methods, Inc., Box 100, Ishpeming, Mich.

Floodlight

A 120-VOLT floodlight lamp, said to be specially designed to withstand severe vibration, has been announced by the Westinghouse lamp division. Built to take advantage of a new concept of mounting the filament on tungsten springs, the PAR-38 lamp reportedly is superior to ordinary lamps in any application where vibration is a problem. Such applications include use on mine machinery, portable and movable construction and industrial equipment, and in mountings subject to pronounced wind vibration. The 150-watt lamp has a medium skirted base and will burn in any position.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Push-Puller

A COMBINATION TWO-LEG, THREE-LEG push-puller has been announced by Owatonna Tool Co., Cedar St., Owatonna, Minn. Legs are available in different lengths to vary the reach of the push-puller. By adding connectors, legs can be used in combination.

Air Compressor

A SELF-PROPELLED air compressor in the 250 cfm class has been announced by Schramm, Inc., 900 East Virginia Ave., West Chester, Pa. To be known as Model 250 Standard Pneumatractor, it is available with either gas or diesel power and furnishes 250 cfm of air at 100 psi. Model 250 can be furnished with a front-end winch for added moving power or pulling, a rotary brush for cleaning operations or a snow plow blade.

Truck Tire

FOR ROCK EXCAVATING, mine and quarry work, the Hard Rock Lug Xtra Tred tire is being marketed by the Goodyear Tire & Rubber Co., Akron, Ohio. Made with 3-T nylon cord, the tire is "beefed up" with as much as 30 percent more rubber, by weight in the tread, according to the manufacturer, to enable the tire to wear longer despite cutting and bruising hazards. Wide lugs and thick shoulders tapered down the side of the tire are said to give it powerful pull, grab and traction. It is available in sizes ranging from 14.00-24 to 18.00-33, tube-type, and from 14.00-25 to 18.00-25, tubeless.

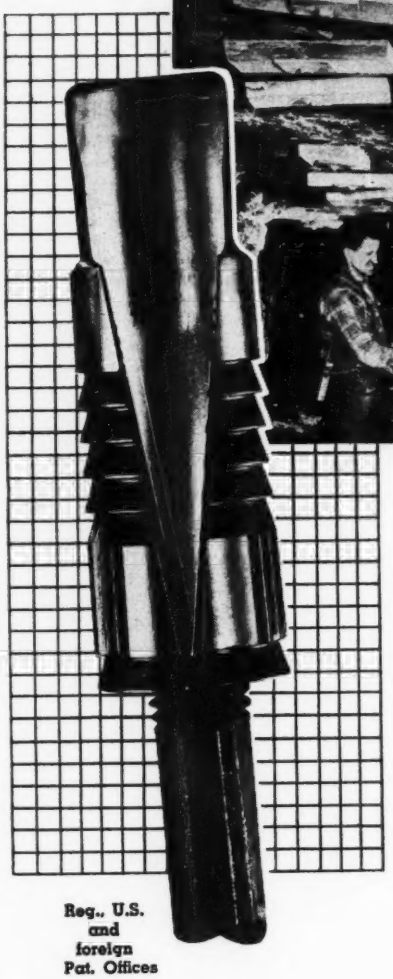
Seminar

A GROUP OF COAL PREPARATION MEN gathered recently in Pittsburgh, Pa., at the invitation of Heyl & Patterson, Inc., to attend a demonstration of the Reineveld Fine Coal Dryer. The main purpose was to acquaint users with the internal parts of this machine and to demonstrate the ease of dismantling and reassembling.

Scraper

AN INCREASE IN STRUCK CAPACITY from 18 to 21 cu yd for Model S-18 Scraper has been announced by the Euclid Division, General Motors Corp., Cleveland 17, Ohio. The scraper bowl has a four-section reversible and adjustable cutting edge and roll-out ejector. All scraper operations—bowl, apron and ejector—are controlled by hydraulic lever action. Other new features are said to include simpler maintenance and servicing.

Power train of the S-18 tractor includes a 325 hp engine and a four-speed torqmatic drive with converter lock-up. NoSpin differential is available as optional equipment.



Reg., U.S. and foreign Pat. Offices

In Western States

PATTIN expansion shells are available and serviced exclusively through Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies may contact them direct for information and consultation.

Most mines can Roof Bolt

Effectively and Profitably ····

WHILE each mine may be different in physical characteristics, in method of operation or types of equipment used—all mines have one problem in common—the problem of keeping the roof in place.

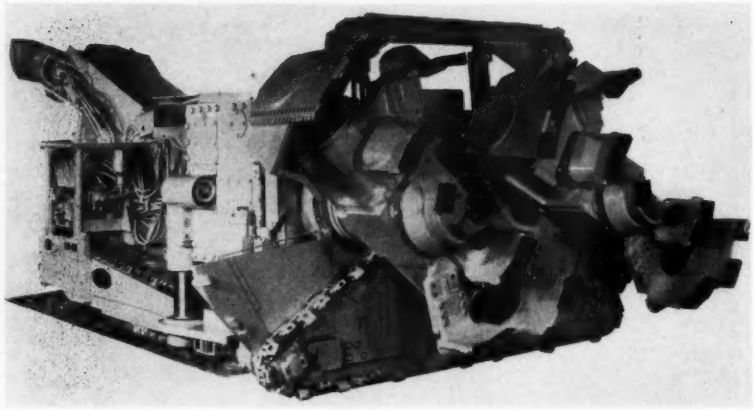
Hundreds of mines, with all different kinds of roofs, have proved that roof bolting is the best form of roof control. They have also found that bolting leads to increased safety, better ventilation and greater production efficiency. Roof bolting offers so many profitable production advantages it justifies any mine, now using conventional timbering methods, making comparative roof support tests. Bolting tests can be made at very little cost.

To be as effective as possible—roof bolting calls for thorough knowledge of the roof strata—well planned bolting patterns and cycles—proper selection of bolts and shells—and adequate supply and service program. Being "The Pioneer in Roof Bolting" —PATTIN MFG. COMPANY, staffed with experienced roof bolting, mining engineers, is capable of meeting every requirement for quality products and service. Your phone call or letter will get immediate attention.

Shown above is the outstanding PATTIN style D-1 expansion shell. Samples of the "D-1" or "D-2" shells will be furnished upon request.

PATTIN MANUFACTURING COMPANY

"69th Year" MARIETTA, OHIO



Continuous Mining Machine With Variable Operating Height

A BORING TYPE continuous mining machine with an adjustable height range that suits it to coal as low as 5½ ft or as high as 7½ ft has been announced by the Goodman Manufacturing Co., Chicago, Ill. Designated the 425 Continuous Borer, it is powered by a single 250-hp a-c or d-c motor and has a rated eight tpm capacity at any height within its range. At 5½ ft the unit cuts an 11-ft wide path, and at 7½ ft the path is 13 ft in width. Roof bolting drills can be supplied for attachment to the machine to permit bolting ahead of the operator and at the left-hand side.

V-Belt

CONSTRUCTED OF NEOPRENE reinforced with Dacron polyester fiber, Boston Woven Hose & Rubber Company's industrial V-belts will be marketed both for original equipment and replacement use. The reinforcing cords of Dacron are said to offer high strength to absorb more shock loading, flexibility, length stability following changes in humidity, and resistance to abrasion, heat, oil, acids, and most alkaline materials. Neoprene, used in the cover and compression member, reportedly provides greater resistance to oils, heat, abrasion, chemicals, and ozone. A dispersion of fibers in the compression member is said to increase flexibility, while at the same time providing improved transverse rigidity to maintain the belt's proper position on the sheave.

Chelating Agent

A PRODUCT FOR THE COPPER MINING INDUSTRY, Imperial CM is a chelating sequestering agent of botanical origin. It reportedly has a two-fold purpose, to raise the grade of concentrate while inhibiting scale deposit in mill circuits. The agent is derived from a plant which lives on naturally calcareous and iron-rich soil and generates chelating substances to keep alive and prevent precipitation of hardness constituents in its veins and system. The product is said to remain stable at temperatures up to boiling at any pH above 4.2.

For further information, contact Dept. R-8, Imperial Chemical Corp., 6505 Wilshire Blvd., Los Angeles 48, Calif.

Flotation Reagent

A PROPRIETARY COMBINATION of alcohols, hydrocarbons and surface-active chemicals, Hodag PX-1 is used as an antifoam, leveling agent and solvent in a broad range of applications, according to Hodag Chemical Corp., 7247 N. Central Park, Chicago 45, Ill. It reportedly can be used as a replacement for pine oil in most formulations and processes where preservative properties are not required. Free samples of PX-1 are available on request.

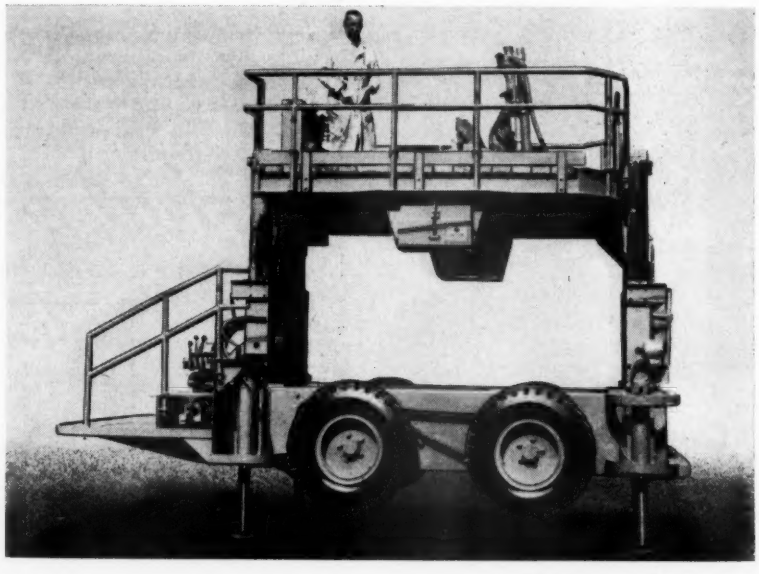
Hi-Lift Stoper

FOR USE IN VEINS OR SEAMS with a minimum thickness of nine to ten ft, the Hi-Lift Stoper designated as Model HSHL-4B is now available, according to Acme Machinery Co., Williamson, W. Va.

The platform itself supports two stopers which are positioned manually on a traveling and traversing bar. This arrangement permits either one or both of the stopers to drill a hole almost anywhere on the platform. The platform has ample lifting capacity to carry safety timbers between it and the roof without fear of collapsing the platform in case of roof fall, and tilts 15 percent front to back to compensate for grade or bad bottom conditions.

Steering and tramming are of the four-wheel drive type with tractor type steering controls. An electric motor provides power for the hydraulic system, but other types of power will be available. Four leveling jacks mounted on the chassis are said to be additional insurance against uneven terrain.

The operators' deck, as well as the platform, are each supplied with a complete set of hydraulic controls for lifting, tramming, etc.



Hour Meter

AN EXPLOSION-PROOF hour meter, specifically designed for use on fork lift trucks, gasoline or diesel engines, generators or air compressors which might be located in hazardous locations have been announced by John W. Hobbs Corp., a division of Stewart-Warner Corp., Yale Blvd. & Ash St., Springfield, Ill. Available for 12 and 32 volt d-c applications, the instrument is housed in an explosion-proof case which is approved by Underwriter's Laboratories under Class 1, Group D specifications. The hour meter tells the actual hours and minutes of engine operation so that lubrication, oil and filter change, overhaul, inspection, cost of specific jobs, fuel and oil consumption, etc., can be planned and recorded. Electrically-wound, the instrument records hours and tenths on an odometer.

Belt Conveyor

A HAMMOCK-STYLE IDLER suspended on wire ropes is said to be a feature of a belt conveyor developed by Hewitt-Robins, Stamford, Conn. The supporting structure consists of prefabricated steel stands of uniform size and shape, held in alignment by parallel ⅝-inch wire ropes on either side of the stands. The wire ropes may also be suspended from the roof of the mine by means of special suspension frames anchored with roof bolts. The belt travels on hinged idler rolls mounted in a hammock-shaped frame. Hinges allow the individual rolls to move freely in a vertical plane so that off-center loading of the belt is automatically corrected without detraining the belt. The hammock frames not only support the idler rolls but also serve as spreaders to keep the ropes in their proper lateral position.

Air Suspension for Tandem Axles

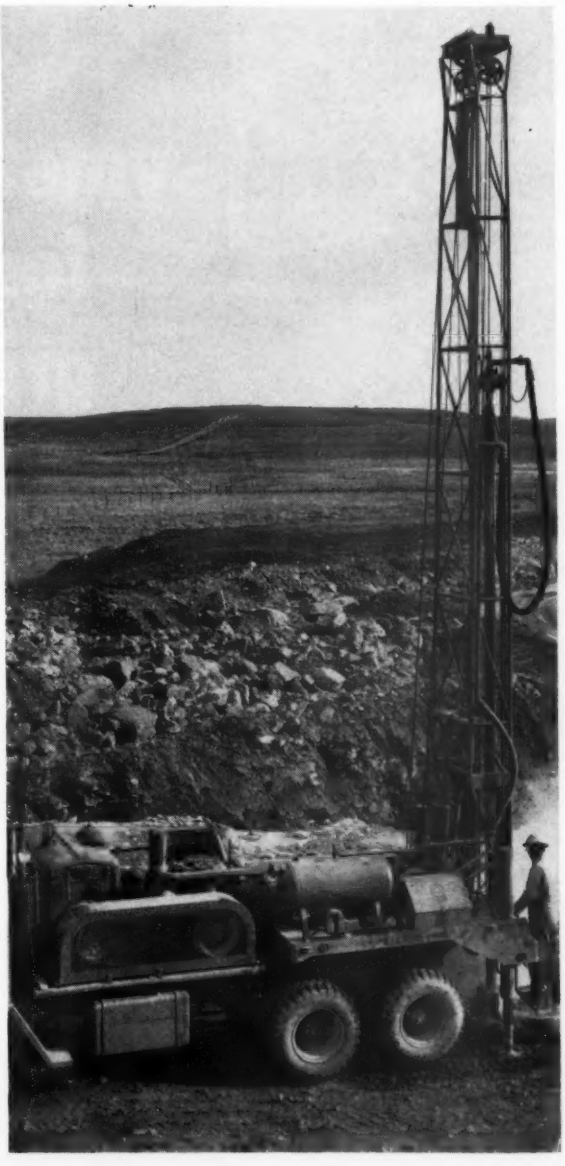
OF ALUMINUM CONSTRUCTION, Series AR airspring suspension is designed for use with all standard axles, both drive and trailer types, according to the Hendrickson Manufacturing Co., Lyons, Ill. The suspension system incorporates an equalizing beam construction which reportedly reduces the effect of road irregularities and prevents load transfer from one axle to another. Accelerating and braking torque are absorbed by Hendrickson's patented vertical drive pin design. Leveling values are said to keep the vehicle frame at a constant height and to automatically compensate for any load with air pressures which vary from 3 to 80 lb. Interchangeability of parts with standard suspension units lessens the need for high parts inventories, and tire wear is reportedly reduced because the air springs give improved ride characteristics while retaining positive axle and frame alignment.

Mining Machine Bits

DESIGNED TO REDUCE SHANK BREAKAGE in standard bit blocks, according to Kennametal, Inc., Bedford, Pa., the mining machine bit is offered in two styles—the U7RB with recessed tip and the U7RAB with cylindrical plug tip. Shanks of the bit have a short rib along each side behind the knockout shoulder. These two ribs produce a cylindrical section of 11/16-in. diameter and 1¼ in. long in the shank where stresses reportedly are greatest. These bits, identified as U7B, do not replace standard Kennametal U7 bits and they differ from recently announced Kennametal U3 bits which require several bit blocks.

Polyacrylamide-Type Flocculant

A SYNTHETIC, ORGANIC, WATER-SOLUBLE POLYMER, Separan NP10 has uniform effectiveness over a wide pH range, according to the Dow Chemical Co. A refinement of Separan 2610, its operational characteristics remain unchanged; all Separan 2610 production has been converted to Separan NP10. Included among product improvements are higher purity, increased solution clarity and greater product uniformity, according to the manufacturer. The new material is used as a flocculant in filtering, thickening and clarification processes in mining and other industries.



Rotary Drilling Rig

A PORTABLE rotary drilling rig, said to be especially designed for use by the mining, quarry, highway, and construction industries, was recently announced by the George E. Failing Co., of Enid, Okla., a subsidiary of Westinghouse Air Brake Co. of Pittsburgh, Pa.

The rig is mounted on a GF-660 Crane Carrier truck with a GMC 4-71 diesel engine. The truck engine furnishes power for the rotary table.

The air compressor on the rig is a Le Roi model 100-S2 and it is powered by a GMC 6031-C diesel engine, with hydraulic full load governor.

The rig is designed to use both conventional type rock or drag bits and also down-the-hole tools. Down-the-hole tools are recommended by the manufacturer for extremely hard formations. Three hydraulic leveling jacks are standard equipment on the unit.

Roof Bolting Machine

HYDRAULIC roof bolting machine called the "Roofcat" has been announced by Schroeder Brothers Corp., McKees Rocks, Pa. This machine is 23-in. high, 36-in. wide (without riding platform) and 8 ft 6 in. long. It weighs 2700 lb and has a tramming speed of 175 fpm. Feed length of the auger sections runs from 28 to 44 in. and will reach 40 to 56 in. roof heights. The Roofcat has dual controls which permits each crawler to be independently operated and its hydraulic system is protected by a micronic return line filter which is built into the tank. A reported feature is the fact that a coal drill can be operated from its hydraulic circuit. Optional equipment includes a gravity or vacuum type dust collector, hydraulic stabilizing jacks, and riding platform.

Electrodes

TWO ALUMINUM electrodes for flat and vertical welding (d-c reverse only) on cast, drawn and sheet aluminum have been announced by All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y. One designated E-43 is for work wherever five percent silicon aluminum—Type 4043—is used. The other, E-2, is for pure aluminum, Type 1100.

Drum Driven by Tires

A 10 BY 30 FT MIXING OR BALLING DRUM, which is driven by eight Goodyear Rubber Co. tires by surface contact only, is being operated by the New York Ore Division of Jones & Laughlin Steel Corp. at Star Lake, N. Y. The tires are inflated with water to a pressure of 110 lb. Two 25-hp motors drive the tires through fluid couplings and speed reducers.

Designed by the resident engineer early in 1956 and fabricated by Lewis & Clinch, Inc., Watertown, N. Y., this drum is believed to be the first of its kind in the industry.

Continuous Mining Machines

TWENTY-FIVE PERCENT HEAVIER than previous Lee-Norse Miners, two new continuous mining machines have been announced by the Lee-Norse Co., Charleroi, Pa. The CM37 (37-in. high) cuts a maximum of 7-ft 3-in. high and the CM47 (47-in. high) cuts a maximum of 9-ft high. The 25-ton machines have three identical electric motors with conservative continuous ratings. Crawler treads are 14-in. wide and are powered by hydraulic motor and gearing. The 24-in. wide conveyor is driven by hydraulic gear motors applied directly to the gathering head. The Miners have multiple tramming speeds providing variable slow speeds to 50 fpm and for fast tramming 90 to 100 fpm.

—*Announcements*—

George E. Clark, president of **Adams Express Co.** has been elected chairman of the executive committee of **Joy Mfg. Co.** Also, **Louis G. Helmick** has been named executive vice president of Joy succeeding **A. B. Drastrup**, resigned, and **John P. Cartwright**, elected vice president and general manager of Joy's Industrial Division. **J. Y. Richards** was appointed to fill Cartwright's former position as sales manager of the Industrial Division.

Milton T. Smith has resigned as president of the **Marion Power Shovel Co.** Prior to joining Marion in 1954, he had been vice president of **Bucyrus-Erie Co.**

Frank J. Durzo has been named vice president in charge of manufacturing by **The Jeffrey Manufacturing Co.**

McGraw-Edison Co. will acquire the business and assets of **National Electric Coil Co.** National Electric Coil operates plants in Columbus, Ohio; Bluefield, W. Va.; Harlan, Ky., and St. John, Quebec. It is expected that the consolidation will be completed by October 1.

The board of directors of **Atlas Powder Co.** have elected Atlas president **Ralph K. Gottshall** chairman of the board, in addition re-electing him as president. As chairman of the board, he succeeds **Isaac Fogg**, who retired August 1.

Charles R. Tyson has been elected executive vice president of The Colorado Fuel & Iron Corp.

Henry E. Pruner, formerly western regional sales manager of conveyor belting sales for United States Rubber Co., has been named marketing manager of the Mechanical Goods Division.

The election of **John Tullis** as executive vice president of **Stratoflex, Inc.** has been announced.

CATALOGS & BULLETINS

GEAR DRIVE. *The Falk Corp., Dept. 255, 3001 West Canal St., Milwaukee 1, Wis.* Detailed information on selections, dimensions and applications on Falk Flange Mounted Drives are given in Bulletin 7140. This gear drive bolts directly to the driven machine. Drives are available for horizontal or vertical application, with high speed shaft up or down. The units are furnished from stock in single reduction for applications of ½-10 hp. and in two double reduction ratios for ½-5 hp.

THERE IS A DIFFERENCE IN DIESELS. *Detroit Diesel Engine Division, General Motors Corp., Detroit 28, Mich.* Brochure covers such topics as Diesel vs. gasoline engines, the difference in two-cycle and four-cycle engines, fuel systems, parts interchangeability, service and others. It includes information on fuel to assist Diesel engine owners and operators in selecting the type of fuel that will result in the most satisfactory operation of their engine.

FORMULA FOR HIGH PRODUCTION. *Advertising Division, Caterpillar Tractor Co., Peoria, Ill.* Form No. DES22 describes the Caterpillar Tractor Co. line of Cat-built Traxcavators and attachments. It also illustrates and describes a wide variety of applications of this equipment.

URANIUM FILM. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* "Power from Uranium" is a 20-minute color film that tells the step-by-step story of the mining and processing of uranium. Prints can be obtained from Allis-Chalmers regional sales offices or from the Industries Division's Advertising Department, Milwaukee.

THREE PNEUMATIC HANDLING SYSTEMS. *Fuller Co., Catasauqua, Pa.* Three basic pneumatic handling systems for moving dry bulk materials are described and ilustrated in Bulletin No. ER-G-2. Reprinted from a technical report, the bulletin includes block diagrams depicting the relationship of equipment components for straight vacuum, straight pressure and combination pull-push pneumatic handling systems. Text material offers case history examples on installation, capacities, efficiency and economy in representative industries. Also included is a table of typical materials conveyed in pneumatic handling systems.

CONTINUOUS MINING MACHINE. *Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago 9, Ill.* Catalog G-136 describes the company's variable height continuous borer. The type 425 borer, because of its cutting height range of two ft, is said to be the answer to the mine that encounters a varying seam thickness or to the mine management that operates several mines with coal height from 5½ to 7½ ft.

ROOF BELT CONVEYORS. *Joy Manufacturing Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa.* Latest design of the Joy Limberope rope belt conveyor system is explained in Bulletin GG-6C. The brochure's spacing tables show proper placement of idler support stands, and anchor points for various material weights and height limitations. Specifications of components are given.

(Continued on next page)

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WIRE ROPE LUBRICANT. *The Whitmore Manufacturing Co., Cleveland 4, Ohio.* The brochure describes the applications of Whitmore's Wire Rope Lubricant. Formerly called cable composition, the product is used to minimize friction and eliminate corrosion in wire rope on many types of machinery, including draglines, steam shovels, elevators, and loading equipment.

1957 FLOTATION INDEX. *Mining Chemicals Sales, The Dow Chemical Co., Midland, Mich.* The "Twenty-Eighth Annual Addition, the Flotation Index," a bibliography of articles and patents of particular interest to the mining and milling industry which appeared in 1957, has been issued by The Dow Chemical Co. Compiled by Dow's mining and metallurgical technical personnel, the 1957 Index is world-wide in scope and lists articles on flotation research, milling operations and mineral dressing in general.

LOCKERBASKETS. *Moore Co., 1036 Quarrier St., Charleston, W. Va.* Eight-page booklet describes and details the design of changerooms employing chain-operated lockerbaskets for overhead storage of clothing and personal effects.

BIN LEVEL INDICATORS. *The Bin-Dicator Co., 13946-216 Kercheval Ave., Detroit 15, Mich.* Catalog describes three products made by the Bin-Dicator Co. for all bulk material, level indication and control. The catalog includes photographs, cutaway and schematic drawings, outline dimensions, general specifications, special bin and conveyor applications, actual and suggested systems and applications for the Bin-Dicator, the diaphragm type bin level indicator; Roto-Bin-Dicator, rotating paddle type bin level indicator; Bin-Flo Aerator, to promote flow of dry, finely ground bulk materials.

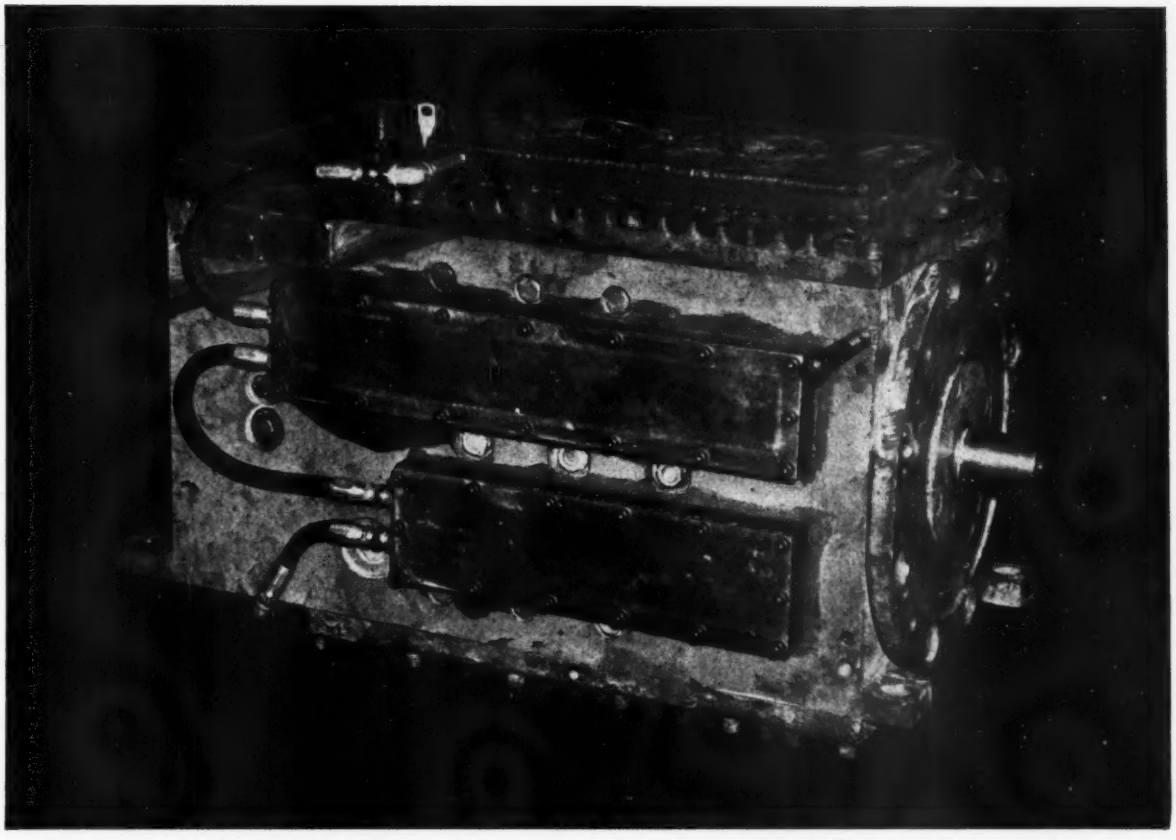
TRUCK AIR BRAKE HOSE. *Advertising Dept., Aeroquip Corp., Jackson, Mich.* Industrial Engineering Bulletin 33-A describes Aeroquip Truck Air Brake Hose and Segmented Fittings. The hose meets the requirements covered in S.A.E. Specification 40R2, and is manufactured in two types: 2550 Type A Hose, mandrel-made and available in lengths up to 60 ft; 2570 Type B Hose, available in coils up to 300 ft. Typical appplications for the new hose include tractor-to-trailer lines, axle chamber lines and tractor service lines on buses, trucks, off-the-highway vehicles and military equipment.

WIRE ROPE DATA AND TABLES. *E. H. Edwards Co., Butler Road & Industrial Way, South San Francisco, Calif.* The reference manual contains data, tables and information most frequently needed by the buyer and user of wire rope.

FREE CIRCULAR SLIDE RULE. *General Industrial Co., 5738 Elston Ave., Chicago 30, Ill.* General Industrial Co. has introduced a handy circular slide rule for engineers and for other plant and office executives. Instructions are included with each pocket-size calculator. To those who do not qualify as an engineer or other business executive to receive a free slide rule—the company will be pleased to send one for 50 cents.

CENTRIFUGAL PUMPS. *Worthington Corp., Advertising & Sales Promotion Department, Harrison, N. J.* Bulletins No. 6525-S5 and No. 6525-S6 describe Worthington Corporation's Model 15M and 20M contractors' pumps, respectively. Both of these centrifugal pumps incorporate a replaceable cast iron recirculation port that eliminates valves and permits renewal of internal clearance. The self-priming pumps are engine driven, but are also available as motor driven units.

Index to Advertisers



How NATIONAL Ingenuity Helped Solve A Tough Motor Maintenance Problem

This motor drives a continuous mining machine. Operation of the machine under certain unusual conditions caused overheating and eventual failure of the motor. National not only repaired the damaged motor but helped the customer plan modifications to prevent recurrence of the difficulty.

Water jackets (as shown in the photo) were added at carefully selected locations on the motor frame. Water used to spray the coal during the mining operation is first circulated through these jackets, thus bringing the operating temperature of the motor down well within workable limits.

An unusual solution, perhaps, but one which typifies the ingenuity which National engineers apply to the job of eliminating the cause of electrical equipment failures. Improvement, not merely repair, is always the objective.

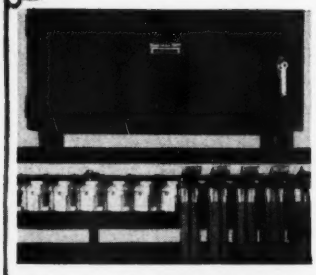
For details on how National redesign ingenuity can help *you* eliminate your tough motor maintenance problems, just call your nearby National field engineer or drop us a line.

NATIONAL ELECTRIC COIL COMPANY

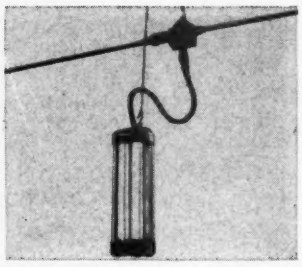
COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

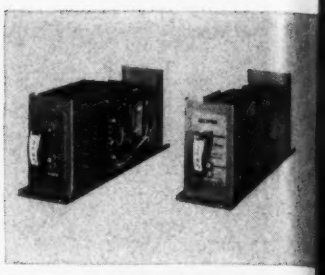
☐ **EDISON R-4 ELECTRIC CAP LAMP** provides brilliant, unfailing light. Assures greater safety for the miner, higher production for the operator. Easy to use and maintain. Adapts to any lamp distribution system.



☐ **M-S-A® AUTOMATIC LOW-VOLTAGE SYSTEM** is designed for the most economical method of lamp charging. Miners can put their lamps on charge with one motion and keep moving without any delay.

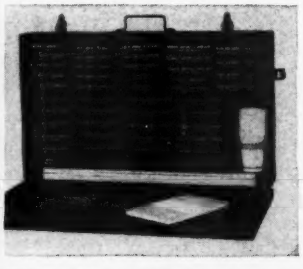


☐ **M-S-A PERMISSIBLE MINE LIGHTING SYSTEM** cuts down accidents. Increases production. Provides dependable lighting with an instant start circuit. Available for either 110 or 220 volt AC circuits.



☐ **M-S-A TRANSISTORIZED AUDIO TONE TRANSMISSION EQUIPMENT** permits economical centralized control and indication of fans, substations, motors, pumps, conveyor belts, switches, circuit breakers, and lights.

☐ **M-S-A MINEPHONE** coordinates trip traffic for safe, fast, productive haulage control. Motormen have clear, instant voice communication with the dispatcher or other motormen while trips are moving.

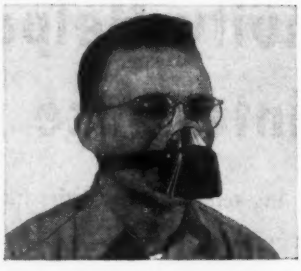


☐ **M-S-A MINER'S FIRST AID CABINET** provides medical dressings and equipment for mine hospital or dressing station. Each unit package individually wrapped in cellophane. When open, lid serves as a work shelf.

☐ **M-S-A ALL-SERVICE® MASK** with new Window-Cator canister, external check valve and M-S-A Cleartone Speaking Diaphragm gives dependable breathing protection against smoke, toxic gases and fumes.

☐ **M-S-A CHEMOX® BREATHING APPARATUS** completely safeguards breathing while travelling through any gaseous or oxygen deficient area. Generates its own oxygen supply from replaceable canister.

☐ **M-S-A SELF-RESCUER®** gives immediate breathing protection in emergencies caused by fire or explosion. Compact. Lightweight. Can be stored without deterioration. Available in storage cases or individual carrying cases.



☐ **M-S-A DUSTFOE RESPIRATOR** is light and compact for dependable protection against dusts, vapors, and mists. Allows maximum vision by the wearer. It's easy to clean. Design is modern and functional.

☐ **M-S-A CHEMKLOS** are made throughout of Dynel. These serviceable gray work clothes resist acids, caustics, mildew and moths. Styled for comfort and good looks. Available in coveralls, trousers and shirts.

☐ **M-S-A TYPE K SKULLGARD HAT WITH NEW FIXED CROWN SUSPENSION** is safest on the outside, safest on the inside. New suspension provides an extra margin of safety which is completely tamper-proof.

☑ CHECK ITEMS OF INTEREST

We will furnish further details

Check off the MSA products which you would like to know more about. Then tear out this ad, send it to MSA. We will send you the additional information requested.

Stop in and see us at the Mining Show in San Francisco: Booth 1500. We will be there with these products. An MSA representative will be pleased to relate the advantages of these items to your operation: in terms of full-shift protection, more tons per man.

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